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Thirty-first Annual Report

OF THE

Department of Scientific and Industrial Research

Presented to the House of Representatives by Leave

COMMONWEALTH MYCOLOGICAL INSTITUTE
23 OCT 1957

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MINISTER'S STATEMENT

THE reports of the Department of Scientific and Industrial Research and of the Council of Scientific and Industrial Research for the year ended 31 March 1957 are presented herewith.

I wish to express my appreciation of the work of members of the council for the time and thought they have given to the consideration of a number of important matters of scientific policy, and in discharging their statutory functions. In particular, I should like to thank Mr McKillop and Dr Purves who retired last year, and to welcome Mr J. Andrew and Dr F. J. Llewellyn as new members.

The Government has given careful consideration to the provision of facilities for research in nuclear sciences, and I have to report that Cabinet has approved in principle the establishment of a Nuclear Research Institute to be equipped with a high-voltage particle accelerator and, at a later stage, a research reactor, at a total cost approaching £500,000. I am now consulting with the University of New Zealand, the D.S.I.R., and others concerned, with a view to formulating the details of the organisation required.

Last year I drew attention to the contribution which this country is making to the work of the International Geophysical Year. I am pleased to say that good progress has been made in preparing for this important event. Physicists and geophysicists in the D.S.I.R., and their colleagues in the University and in other Departments, are doing everything possible to make a worthy contribution to the fund of knowledge which will influence so many facets of human activity.

It is with a considerable degree of relief and satisfaction that I am able now to state that the Department's Geological Survey, with its valuable and irreplaceable collections and records, is being provided with new fireproof accommodation. Three floors of the new State Fire Insurance Building at Lower Hutt have been allocated to this branch and will be ready for occupation later this year. It is also pleasing to note that the new buildings being erected at Lower Hutt for the Dominion Laboratory are nearing completion. These buildings will replace those portions of the present laboratory which have to be vacated to permit of site-clearing operations at Sydney Street. It is hoped that before long it will be possible to house the whole of the Dominion Laboratory at Lower Hutt.

The wide scope and value of the research work of the Department and the essential scientific services which it provides are indicated in the accompanying reports. It remains for me to record my appreciation of the work of the Department and here, too, I should like to thank the staff for the loyal and willing service they have given during the year.

R. M. ALGIE,

Minister in Charge of the Department of Scientific and Industrial Research.

REPORT OF THE COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

The Hon. R. M. ALGIE, Minister in Charge of the Department of Scientific and Industrial Research.

WE have the honour to submit herewith the report of the Council of Scientific and Industrial Research for the year ended 31 March 1957.

The council consists of a chairman and not more than eight other members, not more than two of whom may be "officers employed in the service of the Government". The membership of the council at 31 March 1957 was:

D. F. Sandys Wunsch, O.B.E., M.A.(Oxon), B.Sc. (McGill), M.I.Chem.E., Assoc.Inst.M.M., F.N.Z.I.C., (Chairman).

G. A. Currie, B.Sc.(Agr.), D.Sc., Hon.LL.D.(Aberdeen), Hon.Litt.D. (Western Australia), Hon.LL.D.(Melb.) (Deputy Chairman).

J. Andrew, C.B.E.

M. M. Burns, M.Sc.(N.Z.), Ph.D.(Aberdeen), F.N.Z.I.C.

J. F. Filmer, D.V.Sc.(Melb.).

F J. Llewellyn, Ph.D., D.Sc.(B'ham), F.R.I.C., F.N.Z.I.C., F.R.S.A.

E. Marsden, C.M.G., C.B.E., M.C., D.Sc.(Manc.), Hon.D.Sc.(Oxon), M.I.E.E., F.R.S., F.R.S.N.Z.

D. M. Rae, M.A., Dip.Ed., F.R.Hist.S., M.P.

J. S. Watt, M.Sc.(N.Z.), D.Phil.(Oxon).

W. M. Hamilton, M.Agr.Sc., D.Sc., N.D.H.(N.Z.) (Secretary).

Mr McKillop and Dr Purves retired on rotation on 31 December 1956, and the vacancies were filled by appointment of Mr J. Andrew and Dr F. J. Llewellyn for a period of four years from 1 January 1957.

Five meetings of the council were held during the year, and its various committees met regularly. The council wishes to take this opportunity of expressing its appreciation of the valuable work done by members of its committees.

RESEARCH GRANTS TO BODIES OUTSIDE THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

The council continues to recommend annual grants to university colleges and to other institutions to encourage research, frequently in subjects ancillary to the main programme of the Department of Scientific and Industrial Research.

At each of the two agricultural colleges, for instance, the sum of £8,000 has been granted annually for some years to support research into a large number of problems concerned with soils, farm plants, and animals.

At the constituent colleges of the university the council supports with substantial grants a number of research projects such as radio research at Auckland, research into meteor showers at Canterbury, and the Industrial Development Department at Canterbury University College. At Victoria University College it meets a considerable part of the cost of the special investigations of ironsands.

The grants to university colleges, including the colleges of agriculture, have for some years amounted to approximately £30,000 annually, and

moneys so spent enable a large amount of research to be carried on by members of university staffs and others who would be severely handicapped in their work without this aid.

In addition to those for university research, grants are made to allied institutions, to research institutions, societies, and associations. At the Dairy Research Institute at Palmerston North and the Cawthron Institute in Nelson such grants provide approximately half the total funds available, and research associations are subsidised from the same source.

Altogether, including grants to university colleges, research institutions, and otherwise, the Council of Scientific and Industrial Research recommends annually the expenditure of over £140,000 to assist research or the work of organisations concerned with research. These grants, although met from the vote of the D.S.I.R., are outside the regular programme of research and scientific services of the Department.

RESEARCH ASSOCIATIONS

The council is mindful of the importance to the country of stimulating research, and the application of its results, in the manufacturing industries in order that they may be based on sound technological practice and enabled to keep in step with modern developments, hence its special concern for the work of the research associations.

During the past year the Manufacturers' Research Committee of council has visited several of the incorporated industrial research associations and made a thorough review of their programmes of work, finances, and activities in general. These periodic reviews are very valuable, particularly in that they enable a greater appreciation to be obtained of the important work that these research organisations are undertaking for industry, and also as they provide opportunities for appropriate recommendations to be made for their future development.

Arising from recommendations made in the case of the New Zealand Woollen Mills' Research Association, proposals have been formulated for the expansion of this organisation to undertake research for the wool-scouring industry and for any other sections of industry utilising wool that may require similar facilities. In the case of the New Zealand Fertiliser Manufacturers' Research Association, recommendations made in regard to increasing the amount of effort on works' production problems are receiving attention. The Committee has been concerned for many years with the need for raising the level of technology in the foundry industry and is now pleased to note that the industry is showing increasing interest in the application of scientific methods.

The Committee considers that in some industries a lack of facilities for higher technical education in this country places manufacturers at some disadvantage in applying the results of scientific research, and it is gratified to learn that steps are being taken to implement the Education Department's policy for higher technological education.

Last year mention was made of the formation of the New Zealand Meat Industry Research Institute, as an incorporated research association, and it is pleasing to note that the institute has now appointed the nucleus of a strong staff, mainly of officers formerly employed in the D.S.I.R., and, while housed in temporary premises, has embarked on a series of projects of importance to the industry. A site for the institute has been provided at Ruakura by the Department of Agriculture as the initial step in the establishment of permanent headquarters.

RESEARCH EXPENDITURE IN THE DEPARTMENT

D.S.I.R. expenditure for the last eight years and estimates for 1957–58 are shown in the summary below, together with a column showing the expenditure as a percentage of the gross national product (national income).

Year	Total Staff at 1 April	Gross Expenditure	Cost Per Staff Member	Gross National Product	D.S.I.R. Expenditure as Percentage of National Product
		£(000)	£	£(m.)	
1949–50	939	959	1,021	556	0·173
1950–51	981	962	981	696	0·138
1951–52	997	1,096	1,099	722	0·152
1952–53	1,012	1,010	998	754	0·134
1953–54	931	1,089	1,170	837	0·131
1954–55	937	1,149	1,226	923	0·124
1955–56	928	1,213	1,307	982	0·123
1956–57	946	1,404	1,485	*	*
1957–58	972	1,490	1,533	*	*

* Figures not available.

Your council has noted with concern the decreasing percentage of the gross national product spent on research through D.S.I.R. since 1949–50. As shown in the table above, the percentage of the national product allocated to D.S.I.R. has fallen from 0·173 per cent to 0·123 per cent. D.S.I.R. expenditure in 1955–56 (£1,213,000) would require to have been increased by no less than £470,000 to a total of £1,683,000 to equal the same percentage of the gross national product as in 1949–50.

The D.S.I.R. in New Zealand spends approximately half the funds allocated by Government for scientific research and service. Total expenditure by Government in 1955–56 on scientific work was approximately £2·48 million, equal to 0·25 per cent of the gross national product, or £1·16 per head of population. Similar figures for the United Kingdom, United States of America, and Canada are as follows:

Government expenditure on Scientific Research	U.K.	U.S.A.	Canada	N.Z.
As a percentage of gross national product	1·3	0·58	0·52	0·25
Per head of population ..	£4	£4·9	£3·2	£1·16

The differences shown above would be still more striking if expenditure on research by industry were included.

RESEARCH PAYS HIGH DIVIDENDS

There is ample evidence of the dividends paid by research in New Zealand. The discovery that "bush sickness" could be corrected by cobalt is now providing sufficient income to pay for the whole of the research activity of the country. Examples could be multiplied many-fold, and the council is convinced that much larger sums must be devoted to research in the future if New Zealand is to make adequate provision for her rapidly increasing population.

With this in mind, council proposes during the coming year to survey the research at present being undertaken in New Zealand, and make firmly based recommendations for a policy of planned expansion of research facilities to cater for existing and foreseeable needs.

Among the more profitable lines of research that might then be considered are road research and building research. An organisation for the latter was considered by the council some time ago, but its recommendations failed to come to fruition. The council considers the failure to be regrettable, and is convinced that a successful building research organisation could improve housing conditions and lower costs of building.

The council considered proposals put forward by the Royal Society of New Zealand for the establishment of a Fuel and Power Institute, the purpose of which was to examine the future fuel and power needs of the Dominion, and to conduct or sponsor research in this field. While council could not recommend the setting up of such an institute in the form proposed, it did agree that the need exists for some better facilities for the co-ordination of development and research into all the various sources of fuel and power, and would welcome and support in principle efforts to effect such co-ordination whereby the application of scientific considerations could be brought freely and continuously to the examination of the various problems involved.

DEPARTMENTAL EXPENDITURE

Expenditure by the Department in 1956–57 is shown in the table below:

Table of Expenditure 1956–57

Branch	Staff 31 March 1957	Salaries	Other Expenditure	Total Expenditure 1956–57	Voted 1956–57
Head Office	74	60,866	11,162	72,028	71,310
Animal Ecology Section	7	6,419	2,353	8,772	8,760
Applied Mathematics Laboratory	18	15,271	1,616	16,887	17,670
Auckland Industrial Development Laboratories	30	26,627	10,006	36,633	37,490
Botany Division	20	18,474	6,479	24,953	24,360
Crop Research Division	49	35,231	17,113	52,344	49,420
Dominion Laboratory	144	121,004	47,855	168,859	170,870
Dominion Physical Laboratory	172	126,358	68,280	194,638	196,430
Entomological Research Station	16	14,183	10,096	24,279	25,470
Fats Research Laboratory	17	14,481	5,447	19,928	19,630
Fruit Research Station	24	19,669	15,142	34,811	35,700
Geological Survey	65	54,445	19,690	74,135	75,180
Geophysics Division	72	60,740	100,134	160,874	153,730
Grasslands Division	67	53,702	37,016	90,718	89,410
Hop Research Station	4	3,306	3,896	7,202	6,970
Information Bureau	24	17,621	22,980	40,601	40,450
Plant Chemistry Laboratory	23	16,977	8,898	25,875	23,950
Plant Diseases Division	54	48,265	23,854	72,119	70,360
Scientific Liaison Services	2	7,115	4,485	11,600	13,540
Soil Bureau	73	66,879	22,604	89,483	87,490
Tobacco Research Station	5	4,355	4,586	8,941	8,840
Wheat Research Institute	9	8,247	2,049	10,296	10,090
Research General	..	..	10,674	10,674	10,840
Scholarships	..	..	7,568	7,568	7,460
Miscellaneous	..	..	398	398	498
Grants—					
Universities and agricultural colleges	..	..	33,100	33,100	35,100
Incorporated research associations	..	..	42,809	42,809	70,876
Statutory and miscellaneous	..	..	63,773	63,773	37,106
	969	800,235	604,063	1,404,298	1,399,000

STAFFING THE DEPARTMENT

The actual staff employed on 1 April 1956 was 946, but provision was made in the estimates for 39 persons to fill vacancies existing at that date, giving a total of 985. By 31 March 1957 the Department had filled 23 of these vacancies, making the actual staff at that date 969, as shown above.

The staff at 31 March 1957 comprised professional 369 (366); clerical 160 (160); technical 378 (370); others 62 (50). (Figures for previous year in parentheses.)

The problem of attracting and retaining outstanding scientific officers in the service of the D.S.I.R. during a time of acute world shortage and strong international competition was given very careful consideration by the council. It is heartening that following upon urgent representations by the council, the Government approved increases in the salary scales for scientific officers. While it is hoped that these increases have improved the morale of the staff, the council wishes to draw attention to the continuing importance of maintaining reasonably competitive scales, and to the advantages that would follow from greater financial recognition of the responsibilities of directors of branches of the Department.

The council notes with satisfaction that the Government, through its various appropriate agencies, is making a substantial contribution to the work of the International Geophysical Year. A number of branches of the D.S.I.R. are involved, and we are aware that while our scientific resources are small in comparison with those of larger countries, every effort is being made to make our contribution a worthy one.

The decision of the Government to proceed with the development of nuclear research has the full approval of the council. Research work in this country in very many directions will be aided and speeded by the use of these new and powerful tools, and they will also make possible the training of young scientists in some of the techniques of nuclear science. The council is certain that the not inconsiderable expense entailed is very much worth while.

The council is also pleased to know that the Department's Geological Survey is shortly to be transferred to new fireproof accommodation where its valuable collections should be safe; that new buildings are being erected at Gracefield for part of the Dominion Laboratory; and that approval in principle has been granted for new buildings for the Botany Division at Lincoln.

Your council hopes that the Controlled Climate Installation it recommended may also come into being at Palmerston North. A comparatively new tool, it should prove a very powerful aid in solving several somewhat intractable problems of plant and animal life – and death.

Your council appreciates your reference to it from time to time of problems with a scientific content. It finds in them some justification for its own existence, hopes that it has been able to be of some assistance to the Government in the past, and trusts that it will be given further and wider opportunities for service of the same nature in the future.

D. F. SANDYS WUNSCH, Chairman.

SECRETARY'S REPORT

The Hon. R. M. ALGIE, Minister in Charge of the Department of Scientific and Industrial Research.

I HAVE the honour to submit herewith the annual report of the Department for the year ending 31 March 1957.

In order to make room for the new Government office block in Bowen Street, a large part of the Dominion Laboratory accommodation and part of that used by the Head Office will be demolished. New buildings for the Dominion Laboratory are being erected at Gracefield; the first building is expected to be occupied in June, and the remaining units before the end of the year.

Arrangements have also been made for the Geological Survey to occupy the top three floors of the new State Fire Building at Lower Hutt. This space is expected to be ready for occupation later this year and will, for the first time, provide modern fireproof accommodation for the Survey and its valuable collections. This is a welcome interim move, but as a long-term policy the Geological Survey should preferably be housed in close proximity to either the Dominion Museum or the university.

The Geological Survey will be celebrating its centenary in 1964 and, with the concurrence of the Government, an invitation has been issued to the International Geological Congress to hold its twenty-second session in New Zealand in that year.

RESEARCH

In the following section a brief review of work completed during the year is given. Items that appear to be of general interest have been selected and are outlined in non-technical terms with sufficient background information to explain the significance of the work. No attempt has been made to cover all work completed, but a complete list of all scientific papers published during the year is given following the list of projects in each branch.

THE VALUE OF RESEARCH

A new general purpose wheat, Aotea, bred at the Crop Research Division, combines very high yields with good baking quality and excellent agronomic characters. The new variety has been tested in comparison with Cross 7 in 85 accurate field trials, sown in different districts, over eight seasons. The average increase in yield, calculated on the individual yields of Cross 7, was 22 per cent. This advance in yield has been achieved without sacrifice of the baking quality of the flour. Re-selections from the bulk line grown in field trials in the 1956–57 season and baked at the Wheat Research Institute were similar in quality to Cross 7. In trials in which Aotea has been compared with Arawa, Aotea has given the higher yield and the better baking quality.

Aotea has short straw, does not lodge or shatter, threshes well, and is more resistant than Cross 7 to leaf diseases. Grain samples of Aotea cannot be distinguished from those of Cross 7. Like Arawa, it was derived from a series of crosses involving several parents. Hofed, derived from the Australian variety Federation, and Hope from U.S.A., were crossed with Cross 7, followed by a further cross with the combination of Dreadnought and Cross 7.

The new variety, which is being released as a replacement for Cross 7 in Canterbury and Marlborough, has been produced after sixteen years of breeding and selection; with the co-operation of the Wheat Research Institute for baking tests, the Extension Division of the Department of Agriculture for field trials, and the many farmers who have made land available for trials over the past nine years.

Approximately 1,000 bushels of Aotea, sufficient to sow about 650 acres, are now in the hands of farmers. It is estimated that at least 27,000 bushels will be harvested in 1958, enough to sow 18,000 acres, which will yield on a conservative estimate 810,000 bushels.

The yield increase over Cross 7 should be, in the first year, 5,000 bushels and in the second 150,000 bushels. The rate of increase up to 1958–59 will be determined by the seed available, but it is conservatively estimated that 45,000 acres will be grown in 1959–60. This should yield about 360,000 bushels more than an equal area of Cross 7, an increase worth at current rates (11s. 6d. per bushel) approximately £205,000. It should be noted that this increase is gained without additional cost to the farmer, it makes a corresponding saving in overseas exchange since it saves us buying a corresponding quantity from Australia, and it represents a continuing annual gain which will increase as the new variety completely replaces Cross 7.

This is an interesting example of the dividends that can be obtained from research in one of our smaller farming industries. The annual return from this one new variety promises to far exceed the total expenditure on wheat breeding work in the last thirty years.

INTERNATIONAL GEOPHYSICAL YEAR

In the scientific world today the International Geophysical Year fills the horizon as the most all-embracing scientific enterprise the world has known. From 1 July 1957 until 31 December 1958 scientists of fifty-five nations at over one thousand observing stations throughout the world will participate in global studies of the earth sciences. Their scientific programmes are backed by Government and private finance estimated conservatively at over £100 million. It is the culmination of a long series of such efforts extending into the distant past; from the first measurement of the size of the earth by Eratosthenes in 300 B.C. to the first and second International Polar Years in 1882–83 and 1932–33. The IGY will be a fit successor to these earlier enterprises in geophysics, far surpassing them in scope and intensity.

The earth sciences to be studied during the IGY are concerned with astro-geophysical measurements, meteorology, oceanography and glaciology, ionospheric physics, aurora, and airglow, geomagnetism, cosmic rays, and rocket exploration of the upper atmosphere. The undertaking is international in nature, for each of these fields requires the making of observations and measurements on a world-wide basis, for the problems are global in character. Moreover, these fields are scientifically intermeshed, so that maximum progress can only be made if the technical work in all the fields is performed simultaneously in both space and time. Thus, the compelling reasons for the world-wide programme include the following: to observe phenomena simultaneously and to secure geophysical data from all parts of the earth, and to conduct this effort on a co-ordinated basis in space and time so that the results secured can be correlated in a technically meaningful and productive manner.

The sun provides the reason for the selection of the period July 1957 to December 1958. It is the prime cause of many of the phenomena to be studied. Its influence, however, is cyclic with a period of eleven years in which the frequency of sunspots increases from a minimum to a maximum and then dies away again. The IGY covers a period of solar maximum, for it is during this time that the sun has its most marked effect on terrestrial phenomena such as aurorae, magnetic storms, and ionospheric disturbances, thus making it the most opportune time to study these phenomena and their variations.

New Zealand is in a unique position for participation in the IGY. Her territories and dependencies extend from the tropics to the Antarctic. New Zealand herself lies in one of the meridional zones selected for special study in meteorology and other subjects. Her antipodal position to the United Kingdom and western Europe not only introduces peculiar and important problems in radio communications but also provides conjugate points on the earth's globe for the simultaneous measurement of some phenomena. The oceanography of her surrounding seas is virtually unknown, and she is strategically placed on the Pacific seismic arc for earthquake studies. These factors were recognised when the New Zealand programme was designed; therefore, whilst the scientific resources are small, they have been stretched to the limit to make a worthy contribution to the IGY.

The New Zealand programme, which was approved and authorised by the Government in 1955, includes scientific observations and research studies in meteorology, geomagnetism, aurora, ionospheric physics, solar activity, cosmic rays, geodesy, oceanography, seismology, and gravimetry. The meteorological work is the responsibility of the Meteorological Office and is financed on vote "Air", whilst D.S.I.R. is the executive Department concerned with all the other subjects. However, the following institutions are participating in the programme from their own resources aided by grants from D.S.I.R.: Auckland University College, Victoria University College, Canterbury University College, and the Carter Observatory. D.S.I.R. is also responsible for mounting the IGY Antarctic Expedition, which comprises two parties; one of five scientists which is sharing Scott Base with the Trans-Antarctic Expedition, and a second of three scientists which is occupying jointly with the United States IGY Expedition a station at Hallett Bay near Cape Adair.

From the special financial authorisations approved for the IGY, £56,326 was spent during the financial year ending 31 March 1957. However, D.S.I.R. recognising that this scientific enterprise justified a substantial diversion of effort has borne considerable additional expenditure from its normal allocation.

A considerable proportion of the Geophysics Division's activities has been diverted to the IGY during the year. It is responsible for the whole of the Antarctic programme; the ionospheric programme at Christchurch, Campbell Island, and Rarotonga; the seismological stations at Roxburgh, Wellington, Raoul Island, and Apia; the geodetic station at Wellington for measurements of latitude and longitude; and for the whole of the oceanographic programme. It is pleasing to be able to report that all the preparations for this complicated programme, construction, and installation of equipment and provision of staff, will be completed in time for the commencement of the IGY on 1 July.

After several months devoted to scientific training, testing and packing of equipment, the five IGY scientists, led by Dr Trevor Hatherton, departed for the Antarctic in December 1956. These five scientists under the leadership of Sir Edmund Hillary, not only assisted with the transport of stores and the construction of the base, but also have their scientific equipment fully operational two months ahead of the required date. By early March the ionospheric, solar radiation, seismological, geomagnetic, and auroral equipment was already in operation. The tide gauge had been installed, and gravity observations had been made between the Scott Base and the Polar plateau. It is worthy to note that such eminent authorities as Dr Lawrence M. Gould, Director of the United States IGY Antarctic programme, and Dr. Paul Emile Victor, Director of the French Polar Expeditions, were high in their praise, not only of the excellent accommodation at Scott Base, but of the high calibre of the scientific party and the equipment they will operate. The three New Zealand scientists stationed at Hallett Bay are also progressing very well with the installation of equipment.

In December two oceanographic parties left for a three weeks' cruise to the Antarctic on the frigates *Pukaki* and *Hawea*. After escorting the *Endeavour* to the pack ice, the ships returned to New Zealand by separate routes. During this cruise observations were made of the oceanic circulation, samples of plankton and other marine organisms collected, and rock samples and sediment cores taken for geological purposes. This work not only forms part of the IGY programme, but will assist in a better understanding of the water circulation and marine life in New Zealand coastal waters. In addition, tide gauges have been installed at Campbell and Raoul Islands, and others, at North Cape and the Chatham Islands, will be installed shortly.

The ionospheric equipment at Christchurch, which has been replaced by a more modern ionosonde, has been overhauled and will replace the old manual equipment at Campbell Island. The old equipment at Rarotonga will be replaced by modern equipment in April 1957.

The Dominion Physical Laboratory is also taking a major share in the IGY programme. Its primary concern during 1956 was the development and construction of equipment for a unique New Zealand study of radio propagation through the auroral zone. This involved the establishment of a pulse transmitter at Scott Base with six receivers located round the Antarctic continent, at Campbell Island, Invercargill, Hobart, Adelie Land (French), Mawson (Australian) and Graham Land (U.K.). The constructional programme has been completed and all receivers except one are in place. All data from this study will come back to New Zealand for analysis, and are expected to provide valuable information on important communication circuits that pass through the auroral zone.

The second IGY project that is the responsibility of the Dominion Physical Laboratory is the establishment at Invercargill of a composite station. The Dominion Physical Laboratory will study the aurora, using visual, photographic, spectrographic, and radar methods. Valuable equipment has been loaned by the United States IGY authorities for this programme, whilst the Dominion Physical Laboratory has redesigned obsolete Army radar equipment for the radar observations. The Carter Observatory is closely concerned with the auroral programme; Victoria University College, aided by a grant from D.S.I.R., is responsible for

the cosmic ray work; whilst the Radio Research Station, Seagrove, also aided by D.S.I.R. grant, will undertake radio propagation studies at Invercargill. The establishment and operation of the station is under the control of the Dominion Physical Laboratory, with a staff of seven or eight scientists. It will be one of the most complete stations in existence for the study of the aurora in all its aspects, and in this respect is the most important station of a New Zealand north-south chain from Scott Base, Cape Adair, Campbell Island, Invercargill, Christchurch.

URANIUM

The discovery in November 1955 by Messrs Cassin and Jacobsen of radioactive minerals in the Buller Gorge directed attention to the Hawk Crag breccia as a formation hospitable to uranium minerals. Prospecting by Lime and Marble Limited on the north side of the Buller Gorge between Stable Creek and Tiroroa has produced very encouraging results, and substantially increased our knowledge of the field occurrence of uranium minerals in New Zealand.

In contrast to the small "lode" of the initial roadside discovery of Messrs Jacobsen and Cassin, the uraniferous deposits in the area being prospected by Lime and Marble Limited on the opposite (northern) side of the Buller River are of the bedded type, that is, the mineralised bands follow the bedding of the sedimentary host rocks. The very large deposits at Blind River (Canada), Colorado (U.S.A.), and Witwatersrand (South Africa), are of this type. Radioactive minerals in the Buller Gorge region occur in grits, conglomerates, breccias, and siltstones, of the Hawk Crag breccia, which is probably of Cretaceous age. The geological setting and mineralisation displays a striking parallel with that of the Colorado Plateau in age and composition of the host rocks, in the character of the mineralisation, and the association with volcanic dykes and vitric tuffs (ash beds).

In November last year the Geological Survey began a study of the entire Buller Gorge area, embracing the Hawk Crag breccia and the Ohika beds. For this purpose a field office has been established at Westport and a field party has been active in mapping the geology of the area. The object is to understand the structure of the area, the stratigraphy, frequency, and nature of the uraniferous beds. Until this is done no clear understanding of the whole is possible, for as bedded deposits they are intimately associated with the stratigraphy of the area. Mapping is being carried out on air photographs and contour maps prepared from air photographs by the Department of Lands and Survey. In addition, an independent and successful photo-interpretation of geology from air photographs has been carried out in the Wellington office of the Geological Survey. This work enabled a number of predictions to be made that have since proved correct. The presence of bedded deposits on the south side of the river was predicted as a result of air photo-interpretation, and was subsequently confirmed by field work. This discovery by the Geological Survey has altered the entire picture and strengthens the hypothesis that the uranium minerals occur in a granitic phase (Tiroroa facies) of the Hawk Crag breccia. Field work is still in progress.

Parallel to the field investigation, mineralogical studies have been in progress. An early result was the discovery of the main uranium mineral, coffinite, hydroxyl-substituted uranium silicate, a recently discovered

primary ore mineral of the Colorado area. Deposition of coffinite is accompanied by carbonate, pyrite, haematite, and fluorite, the mineralisation imparting a distinctive red and black colouration to the host rock. Like all known bedded uraniferous deposits, the origin of the ores is not clear, the main problem being whether the uranium originated by solution and redeposition of dispersed concentrations in the host rocks or whether the mineralising solutions were derived from outside sources, possibly igneous intrusions, unconnected with the host rocks.

A number of grab samples have been collected from the Tiroroa facies of the Hawk Crag breccia, and some analysed chemically, the balance being examined radiometrically. The samples taken to date show a range of values from less than 0·1 per cent U_3O_8 to as high as 6·4 per cent U_3O_8. The number and type of samples is inadequate for the purpose of assessing the average content of uranium in the beds. Systematic channel sampling is at present under way to provide this information. Overseas, deposits averaging as low as 0·1 per cent U_3O_8 are being worked commercially, but approximately two million tons of ore of this grade would be necessary for economic exploitation.

Field work has been carried out with the active co-operation of officers of the Mines Department. Much surveying has been carried out by a Mines Department engineer, particularly in the Lime and Marble area where all prospecting work has been brought together on one map. Assistance of a Mines Department engineer in obtaining additional ground control for air photograph reduction has been invaluable. Late last year a visit by a mining engineer from the United Kingdom Atomic Energy Authority gave valuable advice and stimulus to the work.

The work by the Geological Survey has maintained the promise shown by the initial prospecting by Lime and Marble Limited. The discovery of similar beds on the south side of the river has enlarged the area calling for detailed prospecting and increased the possibility of the area providing a workable uranium deposit. Mapping, prospecting, and sampling, and finally driving and drilling must be completed before the deposit is proved, but so far it has maintained this promise, and has not failed at any critical point.

In the field of economic geology this project is among the most important carried out by the Geological Survey, and certainly none have held greater potential for benefit to New Zealand.

GEOLOGICAL MAP PROGRAMME

At present, published geological maps on one mile to an inch scale cover approximately one-third of the country, this total including those subdivisions where printed maps are withheld from distribution pending completion of text. Three of these are planned for release with an appropriate text in the near future. There are, however, a number of subdivisions where progress ranges from "text in preparation and maps printed" to "field work in progress", and it is intended to complete the work on these areas.

On the basis of past progress the geological mapping of New Zealand on an inch to the mile scale would not be completed this century. In order to provide a complete coverage of the country it has been decided that the first step should be the publication of a wall map of New Zealand on a scale of thirty-two miles to an inch (1: 2,000,000). The

compilation of data for this map has already been done, and a somewhat generalised version will appear in the New Zealand National Atlas on a scale of approximately 1: 3,500,000.

The next step envisages the preparation of geological maps on a scale of four miles to the inch (1: 250,000) for the whole of New Zealand and its dependencies. The map will be printed in twenty-eight sheets, and the geology of each sheet will be built up from all available published and unpublished material. Where called for, additional field work will be carried out to complete areas and bring old work up to date. Each sheet will carry an explanatory text of the geology of approximately three thousand words alongside the map and will in itself make a complete geological publication. University departments of geology are co-operating where they have suitable material for inclusion. It is intended that this project should be completed by 1963. The present regional bulletin series will be continued, but may begin to lessen as the remaining areas are less suitable for publication in bulletin form and because effort is being diverted on to the four-mile mapping project. In addition, the ultimate objective, the issue of geological one-mile maps (1: 63,360) carrying with them a short geological description of the areas, will be initiated.

With the approach of the end of one hundred years of geological mapping this project can be considered as a geological stocktaking. In short, the proposal is simply to present in a reasonable time and on a reasonable scale a geological map of New Zealand. As indicated, not only will the main islands of New Zealand be mapped, but the island dependencies as well, and already maps have been completed of Western Samoa and the Chatham Islands. In addition, it is hoped to be able to present the geology of the Ross Dependency in this review.

NUCLEAR SCIENCE

Radiocarbon Dating—During the year 90 samples have been dated for Government Departments, universities, and museums; 10 samples for overseas laboratories and 30 for our own investigations. Such a number of requests from overseas have been received for our co-operation in the aging of carbonaceous specimens that a policy on charges for this service has been formulated. The University of Southern California has allocated a fee of $4,000 for a project on ocean cores. Requests from Australia, Nigeria, North America, and South America have been accepted.

By the installation of an eight-channel printometer and a neutron monitor the efficiency and overall accuracy of the counting equipment has been improved to such a stage that the experimental accuracy is now very close to the maximum theoretical accuracy for our equipment.

The work on the "Industrial Effects" reported last year has been completed, proving that the effect observed in the Northern Hemisphere is the same in the Southern Hemisphere. The exchange time for atmospheric circulation between the two hemispheres is less than twelve years, and the mean life of a carbon dioxide molecule in the atmosphere before it is absorbed in the ocean is less than seven years.

Our anticipation of an enrichment in ^{14}C in the atmosphere due to "H" bomb tests reported last year has been substantiated. The ^{14}C specific activity of the atmosphere has been increased by 4 per cent in the period February 1955 to October 1956. An increase in ^{14}C activity

is already apparent in the leaves and recent wood from trees. The examination of the ^{14}C activity of sea water from Makara has been continued, and already an increase can be detected. Further measurements are to be made to prove this increase, and a series of sea-water samples from varying depths have been collected from a station over the New Caledonian Trench. These results should give base-line data on the age of the ocean before the "H" bomb effect and enable us to estimate the size of the upper and lower reservoirs of the ocean.

The radiocarbon equipment has also been used in more fundamental studies showing that 75 per cent of the background counting rate is due to cosmic rays, the nucleonic component of which is responsible for 60 per cent and hard mesons for 15 per cent. The solar flare of 23 February 1956 enabled the contribution of this nucleonic component to be found.

Mass Spectrometry—The preliminary sulphur isotopic survey to examine the origin of sulphur compounds in the Wairakei, Rotorua, and White Island thermal areas has been completed. This survey shows that sulphur in the geothermal area is isotopically different from sulphur in our volcanic areas. Both sources are isotopically different from sea-water sulphate, offering additional support to the assumption that the hot chloride waters issuing from fumaroles are of magmatic origin. Studies on sulphur isotopic fractionation through aerobic and anaerobic bacterial mechanisms have been continued in co-operation with the Division of Fisheries, C.S.I.R.O., Cronulla; these studies have been difficult owing to the extreme rapidity of bacterial processes. An officer from C.S.I.R.O. is at present working in our division to avoid any time delay.

A major project started during the year has been a study of nitrogen fixation by higher plants, in co-operation with Dr Greta Cone, Nuffield Research Fellow. The technique has been developed for the study of nitrogen uptake from enriched ^{15}N atmospheres. It has been shown that certain plants such as *Epilobiums* and *Coprosmas* have the ability to fix nitrogen by some process taking place in leafy shoots. Dr Cone states that "Nitrogen fixation is of general occurrence in the foliage of trees, pioneer shrubs and various weeds; the process goes on in young shoots, perhaps also in flowers and fruit, and is generally associated with pigments, other than the green of CO_2 fixation. The element nitrogen must be much less inert than has been assumed to be the case, and it must circulate rapidly through vegetation and soils".

Theoretical Atomic Studies—A theoretical investigation on the possibilities of maintaining small quantities of material at temperatures up to 1,000,000°C, has been completed and favourably reported on by Harwell scientists.

Consideration has been given to the scope of electronic energy transfer in chemistry and physics, and possible experiments to clarify the mechanism of transfer are planned. It has been suggested that under certain circumstances energy is transferred between atoms in fluorescent material by means which do not involve the emission and subsequent absorption (elsewhere in the material) of radiation. Relevant mathematical calculations have been clarified.

Tritium—Radioactive hydrogen (tritium) like ^{14}C is produced by cosmic rays on nitrogen. Tritium has a half-life of twelve years, and occurs in natural rains as one to eight parts in 10^{18} (one to eight parts in

a million, million, million parts of rain). The concentration that can be detected by radioactive methods requires normal water samples to be enriched by a volume reduction of 2,500, i.e., from 10,000 ml. to 4 ml. Electrolysis plants have been designed and assembled to achieve this reduction. When the method is developed it is hoped to study turnover times for water in bores and springs by making use of the decay properties of tritium, using it as a naturally occurring tracer, and to take advantage of the increase in the natural tritium inventory due to "H" bombs to study atmospheric circulation times.

^{60}Co Source—To undertake studies in radiation chemistry and to have a more powerful source of radiation than X-ray available for experiments in plant breeding, plant genetics and radiation chemistry, it is intended to install a 100 curie cobalt source during the coming year.

Radioactive Fallout—Monthly rainwater samples have been collected at Gracefield to estimate radioactive fallout. A number of stations are being set up in New Zealand for collection purposes. From these samples, experience will be gained on the counting of fission product activity and the separation of radiostrontium and its daughter radioyttrium.

ANALOGUE COMPUTER FOR EARTHQUAKE RESEARCH

This computer, which uses electrical methods to estimate the effects of earthquakes on buildings, has been constructed at the Dominion Physical Laboratory. Normally, buildings of up to ten storeys are analysed, but in special cases, by "pairing" storeys, buildings of up to twenty storeys may be dealt with. This was done in an analysis of the effect of earthquakes on the proposed twenty-storey Civic Administration Building of the Auckland City Council. As no records are available of strong New Zealand earthquakes, the records of four of the strongest earthquakes recorded in the United States were used, and their effect on sixteen different designs of the building was studied.

The computer has also been used to study the effects of earthquakes on ten-storey buildings of different design, and a paper on this subject was presented at an international conference on engineering seismology held in California in June 1956.

The work so far has been confined to buildings vibrating within the "elastic limit" of their constructional materials, but there is evidence that during severe earthquakes some parts of buildings are stressed beyond the elastic limit, and "yield" takes place.

The analogue computer is now being modified to provide yield as well as elastic behaviour so as to gain further knowledge of the behaviour of buildings and other structures in very severe earthquakes.

RADIO FREQUENCY STANDARDS

Work associated with the establishment at Dominion Physical Laboratory of a radio frequency standard for New Zealand has shown that the standard 16 kc/s radio wave transmitted from Rugby is outstandingly reliable as received in New Zealand. This low frequency is propagated round the earth in a very predictable way. Its slight phase-shifts are proportional to the changes in the length of the sunlit path as the earth rotates. The reliability of this radio signal could lead to the setting up of a world-wide navigational aid, and to a complete change in the world-wide organisation of standard frequency transmissions.

GEOPHYSICS IN THE ROTORUA-TAUPO AREA

The recent transfer of all remaining Geophysical Survey staff from Rotorua to Wellington marks the end of a chapter in New Zealand geophysics. It began with magnetic studies in the Rotorua thermal area, and later expanded to cover the area from the Bay of Plenty to Mount Ruapehu.

Systematic work was not commenced until shortly before the war, but since that time geophysical parties have been based there almost continuously, initially at construction camps on the Waikato River and latterly in Rotorua.

Foundation investigations have been carried out at eight Waikato River hydro-electric dam sites and at four on other rivers, each involving several possible sites. An interesting feature of many of these projects was the detection of old river channels which were filled with rhyolite boulders and covered over with pumice deposits. The location of such channels was important because, unless they were sealed off, water flowing through them could by-pass the dam and, in certain cases, endanger the dam itself.

Geothermal investigations began with the work at Rotorua, Awakeri, and Tokaanu at the beginning of the war, and have since been made at most of the thermal areas. Gravity and airborne magnetic equipment was used for delineating the major geological structure of the region, and magnetic, electrical, and seismic equipment for the geothermal steam investigations of Wairakei and other thermal areas.

The first investigational drillholes were completed by the Geophysical Survey at Wairakei, and holes were drilled at Kawerau and Waiotapu before the Ministry of Works moved into these areas. Numerous steam and hot water holes were also drilled for the Tourist Department, the State Forest Service, and for scientific purposes at Rotorua, Tokaanu, Awakeri, and Te Aroha.

Most of the future work involves research and instrumentation which can best be carried out in Wellington.

INVESTIGATIONS FOR COOK STRAIT POWER CABLE

To assist in the preparation of the consultant's report on the feasibility of a Cook Strait power cable, the Geophysics Division carried out intensive observations of geological and oceanographic factors in Cook Strait. The division was able to turn its existing equipment to the investigation at short notice, and continued on various phases of the work for several months. Seismic refraction profiles along several lines crossing the Strait gave a general indication of the depth of hard bed-rock below the sediments. Maps showing the nature of the surface, and near surface sediments were prepared from a large number of sediment and core samples. Details were supplied of the distribution of rock and sediment at the North Island landing. Considerable effort went into measurements of the tidal stream velocities both at the surface and near the bottom, by using current meters and by tracing the movement of dye patches.

During this period New Zealand Oceanographic Institute also completed the second season's studies of the hydrology and plankton of New Zealand in off-shore waters.

FOUNDRY TECHNOLOGY

The major cause of defective castings in New Zealand lies in the moulding sands and clays that are used. An intensive search has been made for workable deposits of sand that would satisfy the requirements of the many different foundry moulding methods, and, in all, fourteen deposits suitable for one or more of these methods were found. Full information was conveyed to industry in the form of a *Catalogue of Foundry Sands of the Auckland Province* issued by the Auckland Industrial Development Laboratories.

All these deposits are now being worked commercially.

A similar investigation is at present in progress for the bonding clays used in the foundries, and some additional sands, including several from the South Island, have been examined.

Following on this work, a conference of foundrymen was held resulting in the formation of the New Zealand Institute of Foundrymen with branches in Auckland, Wellington, and Christchurch.

This has been well supported, membership in the Auckland area at present being eighty-seven. A programme of educational meetings and further experimental work on cupola operation and control has been planned for the coming year.

MEDICAL INSTRUMENTATION

Greatly increased use has been made of the technique of recording dynamic blood pressures throughout the human circulatory system. With the object of determining the characteristics and limitations of the differing hydraulic systems that are encountered in practice, equipment has been devised at the Auckland Industrial Development Laboratories to produce a synthesised waveform representing an arterial pulse.

Thus the performance of a recording system can be determined as a complete unit.

By this means it has been possible to determine the effect on the frequency response of the change in stiffness of catheters and tubing with temperature, or even with aging.

A four-million-volt linear accelerator is shortly to be installed at the Auckland Hospital for deep therapy treatment of cancer. It is important to be able to record the distribution of radiation intensity in three dimensions as various filters and diaphragms are used.

An automatic isodose computer and recorder has been designed which will rapidly plot a whole family of isodose curves in each plane in turn. The method of plotting represents an advance in this field, and it has been possible to make the sequence wholly automatic.

A study has been carried out at the National Women's Hospital on the effect of intravenous administration of pitocen on uterine muscle activity. This has necessitated the development of a fast acting drip rate recorder covering the wide range of 5 to 80 drops per minute. As a result of this investigation it was found possible to specify the drip rate for a particular patient, and a special pump was arranged to deliver the pitocen drip at a positive controlled rate which was independent of the instantaneous venous pressure.

The pump was fitted with an automatic relay control to prevent air being injected in the event of a failure of the fluid supply.

GAS PRODUCTION

A member of Dominion Laboratory staff during the tenure of a National Research Fellowship made a special study of recent developments in the gasification of coal, and since his return has written two important reports on processes which could be applied to New Zealand sub-bituminous coal – the Lurgi process, and "cyclic" gasification.

Conventional methods of gas making (carbonisation) require a specific type of bituminous coal, mined only on the West Coast. The cost of mining this coal and transporting it to the centres of population are the greatest factors that have prevented the economic development of the gas industry in New Zealand. New Zealand sub-bituminous coals, which represent the major part of our coal potential, are much less expensive to mine, and their proximity to the centres of population reduces the transport costs.

Complete gasification or (simply) gasification processes are distinct from carbonisation in that all the carbon of the coal is converted to gas by reaction with steam.

The Lurgi process uses gasification at high pressure, preferably at the coal mine, with the gas piped to the area of consumption. The economic operation of such a process depends on large-scale operation. It has been suggested that as a long-term policy Auckland and Hamilton could be supplied by a Lurgi plant located in the Waikato coalfields.

Cyclic processes, in which the bed of coal is blown alternately with steam and with air, could be used for local gas production on any required scale of operation. Some preliminary work on cyclic gasification of North Island coals has been carried out at the Palmerston North gasworks.

THE SPONTANEOUS IGNITION OF WOOL

The New Zealand wool trade has been plagued almost since its inception with outbreaks of spontaneous ignition in baled wool. As a result of many disastrous ship-board fires in wool cargoes a public inquiry was held in 1894, and in 1906 a Royal Commission of Inquiry sat to investigate spontaneous ignition of both flax and wool. The Commission reported in 1907 and exonerated flax fibre, but considered that wool was dangerous when baled too damp, especially slaughter-works wool. The Commission carried out a large-scale experiment with a shipment of wool deliberately baled damp but no outbreaks of fire took place.

The spontaneous outbreaks of fire continued until 1949 when Dominion Laboratory was asked by representatives of shipowners and freezing companies to investigate the matter. Trade opinion at that time was inclined to blame the fires on damp packing, the freezing works wools being suspect because they had been wet processed and machine dried. Experiments were initially directed at determining all possible mechanisms by which heating could take place in baled wool, and at testing representative samples of all the grades of wool shipped from New Zealand for their reaction to these mechanism. It was found that frictional heat in the dumping press (used to reduce the shipping volume of wool bales) caused negligible heating; that although heat of regain of over-dried wool could cause large temperature rises in the laboratory, such rises were unable to reach ignition temperatures in commerce; that wool bales packed wet rose swiftly to temperatures of about

70°c., but that the more obvious experimental manipulations were incapable of causing these temperatures to rise higher or to cause ignition. Finally, it was found that different grades of wool vary widely in their ability to react with atmospheric oxygen at 100°c. Wool sheared from living sheep reacts hardly at all, wool removed from the skins of dead sheep by the "slipe" process reacts mildly, and some samples of wool removed from the skins of dead sheep by the "pie" process react violently with oxygen, rising in a few minutes from 100°c. to complete combustion. Further experiments starting at lower temperatures demonstrated that some pie wools are capable of self-heating from temperatures as low as 55°c.

It thus became apparent that pie wool was a likely cause of wool fires in commerce. A search was now made of all recorded cases of wool fires of unknown or suspected spontaneous origin and it was found that in many cases pie wool was implicated, although often differently described in the original accounts. To date no fully authenticated cases have been found of spontaneous ignition in baled wool other than pie wool. A programme of research was instituted and it was demonstrated that removal of the animal fat, with which pie wool is contaminated, removes the fire hazard; but despite continuing work the factors responsible in the fat have not been isolated.

On the commercial side, complete control of the spontaneous fires in wool ships has been gained by voluntary regulations within the industry segregating pie wool for shipping, and encouraging the shippers to scour it. However, disastrous fires in the freezing works still continue (at least one each year), and these will continue as long as the pie process is used. Pie wool represents 1½ per cent of the total New Zealand clip, and on occasions fetches prices in excess of top Merino. In collaboration with the freezing industry a new process known as "Slipemaster" is being developed and demonstrated free from risks of spontaneous ignition, and this process will ultimately replace the pie process, being superior to it in almost every respect.

POISONOUS SPRAY RESIDUES ON FRUIT

During the past few years many new spray materials have been introduced for the control of orchard pests. Considerable work has been carried out by Dominion Laboratory in co-operation with Plant Diseases Division with a view to determining spray programmes that will not give rise to excessive poisonous residues on the fruit under New Zealand conditions. As New Zealand regulations for fruit give limits for arsenic and DDT only, the lead given by the United States Food and Drug Administration in setting tolerances has been followed in most instances, and the tolerances allowed there have been used in assessing the satisfactory level of spray residues. In the main, apples have been examined, and to a lesser extent tomatoes, peaches, and quinces, and the work has been extended to cover such vegetables as cabbages, beans, and potatoes.

Parathion residues on apples sprayed throughout the season and harvested 4½ to 6 weeks after the last application contained not more than 0·18 p.p.m., a figure which is well below the recommended tolerance.

Applies sprayed with thiram, ferbam, and ziram, and picked only one week after the last application, contained residues within the tolerances allowed by the United States. Other countries have no tolerance limits.

The insecticide schradan was used experimentally on a number of crops to control aphids, but in every instance residual amounts were found at harvest that preclude the use of this material on food crops.

In many glasshouses phenyl mercury sprays are used to control leaf mould, and the same materials have also been used by sprays early in the season to control black spot on apples. A study of the mercury content of the fruit at harvest has revealed that there is some penetration of the sprayed mercury through the skin into the pulp. It has been found that although untreated fruit contains a small amount of mercury occurring naturally, the cessation of mercury sprays at closed calyx stage allows apples to be harvested containing not more than 0·05 p.p.m. of mercury. This figure is recommended as an acceptable tolerance.

Lead arsenate sprays, if used throughout the season, were found to give excessive residues of arsenic and lead, and were therefore recommended for use only up to the end of December. The use of DDT late in the season gave the necessary control, and did not give residues above the tolerance of 7 p.p.m.

NEW BREAD-MAKING PROCESSES

New bread-making processes coming into use overseas practically do away with the usual long process of dough fermentation. Instead, the main effects on dough of yeast activity are secured through the use of yeast brews in which only a small proportion of the total flour is included. Experiments made many years ago at the Wheat Research Institute pointed to the possibility that conditions could well arise in these brews whereby the yeast could be damaged or even destroyed as a result of a little known constituent in flour. A new study of the relationship between the degree of yeast damage and the relative proportions of flour, water, sugar, and salts present in brews has shown that a yeast toxin present in flour is active only when the concentration of soluble salts is low. The apparently contradictory finding from the Wheat Research Institute's earlier experiments that small additions of flour are harmful and large additions harmless is now recognised as a result of the insufficient mineral salt content of the brew when small amounts of flour are used. The hazard arising from this is not known to bakers, and the new findings are of considerable practical interest.

TRANSPIRATION FROM PLANTS WITH A LIMITED WATER SUPPLY

Under natural conditions, when there is a plentiful supply of water in the soil, it is now generally accepted that the rate of transpiration (water loss) of plants is determined by the weather. Several formulae have been developed to estimate the transpiration rate from standard meteorological data assuming an adequate supply of water. As the soil dries out the transpiration rate falls below the potential rate. Measurements have been made at the Dominion Physical Laboratory of the transpiration rates of mustard plants grown in a controlled environment to determine whether or not a fall in the transpiration rate occurs before the moisture content of the soil reaches the permanent wilting point. The results indicated that the transpiration rate does fall at a critical moisture content, depending upon the experimental conditions, but usually well before the wilting point is reached. The results of this work were reported to a UNESCO Symposium on Arid Zone Climatology held in Australia in October 1956.

In the course of measuring the transpiration decline of excised leaves of various plants, it was found that dew-wetted leaves of some plants had a markedly different transpiration rate from similar unwetted leaves. This result suggested that the deposited water might have had some effect on the stomatal regulation, and measurements were made to study the phenomenon from this aspect. Leaves of perennial salvia were sprayed with water in varying amounts, and transpiration rates measured and compared with paired unwetted leaves. The resulting comparison showed that the stomata closed at a higher moisture content in the wetted leaves, the net result being a conservation of water within the leaves so treated. This work may have some significance from the point of view of the effect of dew on plant growth.

SELECTION OF BULLS FOR ARTIFICIAL BREEDING

During 1956 the Dominion Physical Laboratory and the New Zealand Dairy Board carried out a joint project on the selection of bulls for artificial breeding. This project has contributed to an important improvement in the conception rate for artificial breeding.

In New Zealand, due to the seasonal nature of dairy production, artificial insemination of cows is carried out mainly during a very short season – about seven or eight weeks – during late September, October, and early November. There is only one artificial breeding centre in New Zealand, and transport and distribution difficulties are such that semen can be used on the day of collection in only a few localities. In other localities semen cannot be used until the day after collection or, at weekends, two days after collection.

Bulls selected for this work are all highly fertile by ordinary standards, and all have good records from the point of view of butterfat-producing daughters. It has been found, however, that although all the bulls are highly fertile, they can be divided into three groups as regards the keeping quality of their semen. Semen from the first group produces uniformly high conception rates on the day of collection and for at least two days after collection; semen from the second group produces high conception rates on the day of collection and one day after; while that from the third group gives reasonably high rates only if the semen is used on the day of collection.

To run an efficient service it is therefore necessary to send only semen from bulls in the first group to localities in which it must be used by the second day after collection; and semen from bulls in the third group to localities near enough to the centre for the semen to be used on the day of collection. A planned semen distribution service of this type makes it necessary to classify the bulls from the point of view of semen storage characteristics.

Unfortunately there is, at the beginning of each season, a large number of new bulls in the herd for which the semen storage characteristics are unknown (for example, in 1956 the semen storage characteristics of about 60 per cent of the merit bulls were unknown). Further, although storage characteristics can be assessed from previous season's records for those bulls which have been in the herd for some time, it is, nevertheless, desirable to have some method of assessing the semen, which would reveal any change in characteristics. The problem which was set, therefore, was one of devising a laboratory method for classifying bulls at the Artificial Breeding Centre, from the point of view of semen storage, before the season commenced.

Two methods were devised by the Dominion Physical Laboratory and one of these was shown to be very promising. The method which was adopted is based on the hypothesis that the probability of obtaining a conception would be higher for semen containing a large proportion of motile sperm with a high metabolic rate than it would be for a sample with a high proportion of low metabolic rate sperm. The specific metabolic rate of samples of semen had been determined previously by measuring the minute amount of heat produced, and these measurements, together with biochemical evidence, supported the view that the principal energy producing metabolic activity was the conversion of fructose to lactic acid. Since the chemical determination of the rate of fructose utilisation is a comparatively simple technique, the specific rate of utilisation on successive days after semen collection was used as an index to grade bulls into the three groups mentioned above. The method was applied by the Dairy Board Artificial Breeding Centre to classification of bulls for the 1956–57 season.

Preliminary results were very encouraging, and it is now clear that the selection of bulls for better keeping quality of semen has had an important influence in raising the conception rate from 49 per cent in 1955 to somewhere between 58 and 60 per cent in 1956. Not all of the improvement can be credited directly to the classification method, but it has made an important contribution. A reasonable assessment of the annual cash value of this work in enabling the farmer to have the cows calve during the optimum period is about £20,000 per annum.

SOIL MECHANICS AND BUILDING FOUNDATIONS

Soils and clays are difficult foundation materials for large structures. The springs of a truck compress as a load is put on the tray, but a heavy object supported on clay slowly sinks over a period of time. During this period of consolidation the structure is subjected to changing stresses which could increase to a level capable of seriously damaging it. An engineer designing such a structure with an adequate margin of strength must know the magnitude of these stresses. In order to find the compression properties of the foundation materials, small cylindrical samples of the clay are compressed under a known load and the contraction measured at intervals of time. It is now a mathematical problem of some complexity to transform this experimental information into the figures required in practice. The basis of the transformation is a theory of clay consolidation propounded by the German physicist Terzaghi, which purports to explain the results of the compression experiments in the terms of a single parameter describing the nature of the clay. A value of this parameter is found that gives the closest agreement between theory and the sample experiment, and this value is used in the theory to predict the settlement of the final building.

This theory does not accurately describe the curves obtained for the compression test on some soils, including many of those found in New Zealand. There are two possible methods of adjusting the original theory: the first is to improve on the approximations made in Terzaghi's theory, and the second to introduce more parameters describing the nature of the clay. Both avenues are being investigated by the Applied Mathematics Laboratory, and have led to a better understanding of the experimental curves and a theory of greater generality with little increase in complexity.

SOIL SURVEYS

In addition to work within New Zealand, soil surveys this year include Chatham Island and the two large islands of Western Samoa. The systematic examination and mapping revealed a very wide range of soils; laboratory work on samples is now in progress and when completed will enable the surveys to be written up for publication.

On Chatham Island, peat soils of one type or another cover about 100,000 acres, and dominate farming use of the island. The peats are mainly forest peats which accumulated both in the small swamps of the central lowland and over the extensive rolling to steep slopes of the northern and southern ends. Since the forests were cleared, peat formation has continued under the fern, rush, and moss vegetation which followed the widespread deterioration of pastures. Small areas of soils derived from windblown sands, volcanic ash, basalt, and limestone occur and generally make good land for farming. However, the overall production depends principally on the amount of use made of peat soils. For pastoral improvement these soils require the application of fertilisers, and methods of management suited to peats rather than to mineral soils.

In Western Samoa, forty-five soil types were mapped on Upolu and most of these occurred again on Savaii. This variety is due primarily to the range in climate and to differing age of the volcanic rocks. The effects of climate are shown by the increasing yellowness, silt content, acidity, raw humus, and depth of the soils with increasing altitude. Depth is also related to age of the rocks, as only the older lavas have developed into deep soils. However, increasing age is accompanied by increased loss of soluble plant foods, and the deep soils have only a small stock of plant nutrients. For permanent use for even moderate production the deep soils need fertilisers, and field trials are being made in co-operation with the Samoan Department of Agriculture to find out the best combination of treatments for individual soil types. Many of the soils, both coastal and inland, are well suited to a wide range of tropical plants, and a study of the soil maps together with other maps prepared by the Department of Lands and Survey will indicate suitable ways in which it is possible to develop these resources.

The future prosperity of Samoa depends upon a high level of agricultural production – upon the extension of good farming and upon conserving and building up the fertility of the soil. Many local land customs, including those of temporary land tenure, were suited to an age of shifting cultivation but are not conducive to permanent soil improvement. Until they are modified, the results of the soil survey and of agricultural experiment can hardly be applied to the advantage of the farmers.

IRRIGATION SURVEYS

The programme of detailed surveys of the irrigable soils of Central Otago was further advanced by the completion of surveys of the Ida Valley and of part of the Upper Clutha Valley. Previous surveys of the Maniototo Plains, the lower Manuherikia Valley, and parts of the Clutha Valley have shown that soils with poor drainage in the subsoils or in the underlying strata are widely distributed over Central Otago. Soil conditions in Central Otago are therefore markedly different from those of the Canterbury Plains where soils are generally free draining.

The Ida Valley survey was made as a part of a co-operative study of the soils and agriculture of the valley to assist planning future extensions or modifications of the existing irrigation scheme. During the survey special attention was given to soil properties such as subsoil drainage, porosity of the topsoil, and the amounts of soluble salts in the soils and parent materials. These properties become highly important when irrigation water is distributed by methods which make it virtually impossible to restrict the added water to the depth reached by plant roots. Excess water percolates below this depth, and unless drainage is free collects on the first impermeable horizon and causes waterlogging where this horizon approaches the surface. The amount of excess water percolating to the subsoil depends also on the porosity of the topsoil. If this is porous a large volume of excess water percolates downwards. In the Ida Valley it was found that many of the topsoils were porous and that subsoil impediments to free percolation were widespread over the valley floor. Some soils contained hard pan horizons. At the time of survey, excess water was being applied to most of the soils, and many of the soils were either temporarily or permanently waterlogged.

Soluble salts were found to be widely distributed throughout the valley, and in approximately 5 per cent of the irrigated area they had reached concentrations high enough to restrict the growth of crops and pastures. About 40 per cent of the irrigated soils showed slight concentrations of salts. The soil survey has indicated that close control of the amount of irrigation water applied and adequate drainage is essential to prevent water-logging and avoid problems of soluble salt accumulation. Unless these precautions are adequately observed irrigation will not, in the long run, provide the hoped for increase in production.

SOIL BIOLOGY

Investigations into the biology of soils is being undertaken in the Soil Bureau. The work is focused on grassland soils, the biology of which is little known either in New Zealand or abroad. It includes basic studies to determine the species present, their densities, and their population relationships in different soils over the season. New Zealand offers most favourable material for such studies because large areas of grasslands occur either naturally or have been developed from native grassland areas or from forest.

As a preliminary step, an investigation on native tussock grassland soils in both North and South Islands was initiated to serve as a basis for future studies on the more economically important sown grasslands. The investigations are unique in that for the first time the following groups of organisms have been studied during the four seasons from the same soil sites: moulds, yeasts, actinomycetes, bacteria, protozoa, algae, and earthworms. The populations of the various groups of soil micro-organisms are not all affected similarly by environmental factors. Moulds and yeasts are influenced primarily by type of vegetation, whereas bacteria and protozoa are subject to other soil influences. Moulds generally reach a maximum in seasonally dry, warm soils, whereas bacteria respond more closely to short-term fluctuations in soil moisture. The microbial process whereby nitrogen is converted to forms available to plants is very slow in these soils, while the accumulation of atmospheric nitrogen by micro-organisms other than those in the roots of

legumes is negligible. Few earthworms are peculiar to tussock grasslands; their present distribution has been determined by recent geological, climatic, and associated vegetational changes, and is not directly related to present tussock grassland distribution.

Comparisons of tussock soils and the same soils cultivated, fertilised, and sown to crops or improved pastures have been completed. Despite the marked alterations in soil conditions, microbial populations in general are little altered, although rate of conversion of nitrogen is increased. These results may hold only for lower fertility soils and studies of more fertile soils are now under way.

Soils under forest cover and soils originally under forest but now supporting improved pasture are being examined, and fluctuations in composition and densities of populations in these soils are being compared with results from natural and modified tussock grassland soils.

As a result of this work certain selected, apparently significant, organisms are being examined in detail. Their nutrition, biochemistry, and physiology are being studied in order to learn of their probable role in soil processes. Strains of *Rhizoctonia* and nitrogen-fixing bacteria have been investigated, and a red yeast, occurring in high numbers in top soil and on grass leaves under dry conditions, is being examined.

The observed wide fluctuations in micropopulations with seasonal changes have naturally stimulated interest in their possible role in such seasonal problems as facial eczema. Investigations along these lines are being undertaken.

GRASSLAND RESEARCH

This year has seen the initiation at Kaikohe of the third of the Grasslands substations, the other two being at Lincoln and Gore. At Kaikohe an area of approximately one hundred acres was acquired from the Northland College. This area, although in a derelict state, contains a mixture of soil and topographic types characteristic of Northland, and will thus be of value for investigation of problems related to the development and management of Northland soils. A house and shed have been erected, drainage and scrub clearance are in progress, and plans have been prepared for farm buildings.

The Grasslands Division has a heavy responsibility for an adequate coverage of the country's soil and climatic types, mainly for the testing of the potential of its plant breeding material but also for the study of grassland management in relation to local peculiarities of climate, soil, and farm practice. The Grasslands Division is responsible for pasture plant breeding in New Zealand, and the bred material from this plant breeding programme now forms the basis of the New Zealand certified seed industry. There is no doubt that over the past years this has resulted in considerable pasture improvement and also in a very efficient seed trade. Nevertheless, it must be appreciated that lack of competition in this field could easily lead to complacency with our plant improvement programme unless continuous check is made of the performance of the bred strains under the different conditions through the country. This is particularly so with Grasslands Division's policy of producing strains with a New Zealand coverage rather than ones of only regional application. It is of course known that there may be limitations to such

a policy, but the division believes that so far the overall advantages have outweighed those of regional strains. Thus, there are three primary objects for each substation of the division. These are:

The testing as single plants and in pure and mixed swards, given best cultural and soil fertility conditions, of strains and progenies.

Investigation of deficiencies and difficulties peculiar to the local soil types.

Endeavouring to fit the species and strains into the local farming practice.

A start has already been made at Kaikohe on the single plant testing aspect, using the limited area of land now suitable for this purpose. It is hoped that rapid progress will be made in bringing more land into condition for further work. As a method of further spreading these species and strains testing, arrangements are also being made with the Department of Agriculture, Lincoln College, and several groups of farmers to lay down a widely spread series of single plant trials.

Grazing Intensity—At Grasslands Division work is under way on the relationship of seasonal grazing intensities to the amount of active plant tissue exposed to the light for photosynthesis. Light recordings at different levels in mixed pastures and in pure associations, and the measurement of daily rates of growth after grazing, are producing a much better understanding of the effects observed on mixed pastures under various grazing regimes. For example, with H. 1 ryegrass and clover mixtures it has been shown that the optimum grazing intensity is from 7 in. down to 3 in. For the H. 1, very close grazing and very lax grazing are both disadvantageous, due in the first place to damage to the erect growth of the young tillers, and in the second place to excessive shading by vigorous red and white clover. Detailed leaf area measurements have shown that it is necessary to have the ground covered by some 5 square feet of herbage leaf per square foot of area for maximum photosynthesis. This optimum figure varies somewhat between winter and summer, due to the changing elevation of the sun and its effects on erect and prostrate leaves. Between pasture species and mixtures there are of course quite large differences in the best grazing heights, owing to differences in tillering habits and to palatability changes; it is expected, however, that a continuance of this work will add much to our understanding of pasture grazing, and thus of best farm management for soil, plant, and animal.

PHOTOSYNTHESIS

This has many times been described as the most important biochemical reaction in the world, and it is unquestionably the most important in New Zealand where the national economy is based directly on our pasture production; this in turn is dependent on photosynthetic utilisation of the energy of the sun for the conversion of carbon dioxide of the air into compounds that act as building blocks for plant growth.

Recent studies overseas have shown that when carbon dioxide is taken up into the plant, it first combines with a sugar-like compound to produce a very reactive material from which other compounds are built up by subsequent biochemical processes. The enzyme which carries out this most fundamental step of carbon dioxide incorporation has been shown to occur in plant leaf extracts, but its location in the leaf cell was undetermined and it was difficult to purify.

The work on the proteins of leaf cells, which has been carried out at Plant Chemistry Laboratory for some years, has proved of direct application to this problem. One type of protein which is regularly obtained in the plant extracts was shown to be derived from the green chloroplasts of the cell, where the absorption of light takes place to provide energy for the photosynthetic processes. Using isolated chloroplasts as starting material, it was possible to prepare this particular protein in a highly purified form by a rapid procedure, and it was then shown that this pure protein was in fact the enzyme responsible for carbon dioxide fixation. Thus the role of this particular protein was determined, the location in the cell of the fixation enzyme was established, and the method developed for rapidly purifying the enzyme will enable the details of the process of photosynthetic utilisation of carbon dioxide to form plant material to be further elucidated.

ENTOMOLOGICAL RESEARCH

Insect Survey—Our knowledge of the insect fauna of New Zealand has grown over the years by the work of amateur collectors and professional entomologists in museums, Government Departments, the Cawthron Institute, etc. Most of these people, however, have been interested in a particular group of insects and not in the insect fauna as a whole.

In order to provide a firm basis for allotting priorities in entomological research, an insect survey has been commenced during the past year. Initially, attention has been concentrated on the insects of sown pastures in the North Island. During the past year collections were made at approximately two hundred sampling points widely distributed over the North Island. Each sample may include up to three hundred insects, representing perhaps one hundred species. The identification and classification of the material collected is a major undertaking.

In later years the survey will be extended to cover the whole of New Zealand, and to survey in a similar manner the insect populations of crops, orchards, and the insect pests of farm animals. By this means it is hoped to provide basic information on the distribution of economic insects in New Zealand, and to indicate where the impetus of our research programme in entomology can be best directed.

Manuka Blight—Manuka blight, the causal agent of which is a scale insect *Eriococcus orariensis* Hoy, was first noticed in New Zealand in the Orari River basin in Canterbury in 1946. Since then the causal insect has spread by natural dispersal and by deliberate transfer until it now occurs throughout New Zealand. The insect had not previously been known in New Zealand, and had not been observed in Australia, but our entomologists postulated that it had probably been blown over the Tasman Sea by high winds. In 1956 an officer of the Entomology Division visited Australia to check this hypothesis, and found the insect widespread along the eastern seaboard. *Eriococcus orariensis* in Australia does not lead to the death of manuka since the insect is heavily parasitised. This discovery means that a parasite could probably be introduced from Australia, if this were thought to be desirable. Such an introduction would probably reduce the incidence of manuka blight to a level where it would no longer kill manuka.

Plant Protection in New Zealand—The publication in 1956 of a textbook on *Plant Protection in New Zealand* by the Plant Diseases Division should satisfy a long-felt want in the Dominion. This book of 699 pages with 477 illustrations was prepared by officers of the Plant Diseases Division for the Technical Correspondence School, Department of Education, who arranged its publication. Although a number of the authors are now members of other institutions, they were all members of the division when preparation of the manuscript was commenced. All phases of plant protection in New Zealand are covered, the subject matter being divided into sections dealing with fungous, bacterial, virus and physiological diseases, insect pests, chemicals used in plant protection and soil disinfection, fumigation, and seed disinfection. It should prove invaluable to agricultural and horticultural students, and to all those interested in plant protection.

Wasp Biology—A recent evaluation of earlier field observations by the Plant Diseases Division has led to a better understanding of the biology of the European wasp in New Zealand. Aspects insufficiently stressed previously include the possibility that drone eggs are laid by workers rather than the queen, that queen formation is initiated by the first autumn frosts, and that in the absence of queens the nests overwinter, and the highly significant observation that the sudden change in the diet of workers from being almost entirely predaceous upon insects to having an insatiable desire for sweets occurs when the first drones emerge in the nests. These and other observations give a much better understanding of wasp biology and control.

Timber Preservation—With the increased use of sap wood of timber species, susceptible to attack by insects and fungi, the preservative treatment of timber in New Zealand has become essential. Effectiveness of preservatives and methods of timber impregnation have been investigated at the Plant Diseases Division. As a result of the investigations an effective and economical treatment was developed using boron compounds applied by diffusion impregnation. The Timber Preservation Authority, set up in 1955, gave its approval in July 1956 to the use of boron treatment of timber for use in building construction above ground and where timber is not in contact with liquid water. Since that date the number of commercial treating plants using this method has increased from 7 to 22, with many more being planned. The establishment of this economical treatment method, which is now assured, will have considerable influence on the Dominion's economy.

The division has continued to give advice on design and operation of boron diffusion impregnation plants, but the users of this process, in association, have now employed their own technical staff, and it is anticipated that before long they will be able to handle their own advisory work.

Dry Rot of Swedes—Dry rot is the most serious disease of swedes in New Zealand, and probably causes greater financial losses than any other plant disease in the Dominion. In the autumn of 1956 the perfect stage of the fungus causing dry rot was found on plant residues of a number of brassica crops. The perfect stage gives rise to wind borne spores which may spread infection over long distances. This discovery by the Plant Diseases Division is of major importance in the field of plant pathology, and explains why control measures applied in the past have

so often failed. The finding is of considerable economic significance as it gives a much better understanding of spread of the disease, and changes the whole approach to the problem of control.

Black Spot of Apples—Black spot is one of the most troublesome diseases of apples, and in some seasons growers experience considerable difficulty in securing effective control. Investigations have been carried out at the Plant Diseases Division to ascertain whether improved control can be obtained by giving more careful consideration to time of application of sprays. Information gained from the investigations suggests that disease forecasting for black spot might be feasible and profitable in New Zealand.

Use of a spore trap in the Henderson district showed that in 1956 ascospore discharge by the fungus causing black spot occurred with nearly every rain shower in spring, and was completed by the end of November. On the Dougherty variety, spraying up to the end of November with phenyl mercury chloride after every period suitable for infection kept the trees completely free of black spot, whereas spraying to the normal spray programme with either phenyl mercury chloride or sulphurs permitted a serious infection of black spot to develop.

FRUIT RESEARCH

Grassing Down of Orchards—For the past forty years most New Zealand orchards have been kept under clean cultivation during summer with a cover crop in winter. This practice has disadvantages, particularly on rolling country where erosion becomes a problem. In England, orchards are sown with grass and mown as frequently as a golf fairway, a method claimed to build up soil fertility and improve fruit quality. Six years ago the Fruit Research Station laid down grass plots in Nelson to compare these two systems of management. On mature Jonathan apple trees it was found that those under mown grass yielded some 20 per cent less fruit than those under clean cultivation. This reduction in crop can be partly offset by heavy dressings of nitrogen. Grassing has undoubtedly checked erosion and allowed orchard machinery better access under wet conditions. Other benefits of grassing may become more apparent with time, but over the six-year period clean cultivation has given substantially better returns from Jonathans on the Moutere hills.

Superficial Scald on Cool Stored Apples—Apples in cool store are subject to several non-parasitic disorders that reduce their quality and market value, one of the most serious of these being a blackening of the skin called superficial scald. It is not yet known what causes scald, but for the past thirty years partial control has been achieved by wrapping susceptible apples in oiled paper before putting them into cool store. During the past season the Fruit Research Station has been testing a new American discovery, and results show that diphenylamine used either as a dip or in wraps gives considerably better control of scald than oiled wraps on the important variety Granny Smith. This holds promise of a double saving to the fruit industry. Firstly, with the threat of scald removed it will be possible to extend storage of Granny Smiths into early summer when apples are scarce, and secondly, as diphenylamine can be used in the form of a dip, it will be possible to protect apples stored loose and thus save packing costs.

Rootstocks for Japanese Plums—Recent severe losses from root rot among peaches in the Auckland area may cause an increase in plantings of plums as these resist root rotting fungi much better than peaches. It is normal practice to use cherry plum cuttings as rootstocks for the Japanese type plums that grow well under Auckland conditions. Trials carried out by the Fruit Research Station have shown that better results could be obtained if Japanese plum varieties were grown on Marianna stocks. Of four stocks tested, Marianna was the best, producing a medium sized tree that comes into bearing early, carries heavy crops, and is resistant to root rotting under wet conditions.

TOBACCO RESEARCH

Verticillium wilt, a fungus disease that carries over in the soil, is becoming an increasingly important problem in the production of tobacco. Several fields are already out of production as the result of the disease, and six new areas have been reported this season. Fortunately the disease spreads very slowly, but unless some economic control can be found it is likely that these areas will also be out of production within ten years. Work at the Tobacco Research Station is progressing along three lines: (1) Searching for a resistant variety or strain which can be grown in place of the present varieties or used as a parent in a breeding programme; while no outstanding source of resistance has been found, one variety, Coker 130, does show a degree of resistance; unfortunately this variety is reputed to be of poor smoking quality. (2) Developing laboratory and glasshouse techniques by which breeding material can be evaluated for its degree of resistance; considerable progress has been made along these lines. (3) Investigating the possibilities for soil treatment of the affected areas; both chloropicrin and methyl bromide have given good control in the field; they are practical for spot treatment but their cost is as yet too high for use on an extensive scale.

COMPOSITION OF ANIMAL FATS

Minor Constituents—Whereas up to a few years ago animal depot fats were believed to contain only *n*-even-numbered carbon fatty acids with the range C_{14} to C_{20}, recent work of the Fats Research Laboratory shows that a wide variety of branched-chain and *n*-uneven-numbered carbon fatty acids is present. For example, in a study of hydrogenated ox kidney fat the range of *n*-fatty acids was found to extend from C_2 to C_{26} including the *n*-odd-numbered fatty acids from C_3 to C_{23} except C_{11}. Margaric acid was isolated for the first time from butterfat. Knowledge of the types of unsaturated fatty acids has also been extended by the discovery in lamb caul fat of acids with double bonds separated by two or more methylenic groups. The significance of the newly discovered constituents cannot yet be fully assessed, but their importance may be inferred from the now widespread interest shown in the relation between properties of animal and vegetable fats, and cholesterol deposition as a cause of atherosclerosis.

General Studies—Progress has been made at the laboratory in the preparation of pure phosphatidyl choline and phosphatidyl ethanolamine from the lipids of beef muscle with a view to determining their fatty acid composition. Preliminary studies on the effect of age of ruminants on the composition of their depot fats suggest that until the rumen

functions effectively the proportions of *trans* and branched chain acids are relatively low. Assistance has been given to the Sheep Husbandry Department of Massey Agricultural College in the determination of the amount and nature of the fat in the tissues of overweight ewes following thyroxine treatment. Analysis of the fats from the fatty tissues and muscle of mutton chops showed that the more highly unsaturated (essential) acids are concentrated in the muscle tissues, while the percentage of *trans* acids is higher in the adipose tissues.

Rancidity—Though much work at the Fats Research Laboratory has been directed towards the elucidation of the nature of oxidative rancidity, and the main products formed have been identified, nevertheless, the compounds responsible for the odours and flavours remain largely unknown. During the year a Fulbright Scholar, Professor W. L. Dunkley, initiated a project to explore this field. Progress was made in determining the nature of the compounds responsible for two of the most important (Kreis and Thiobarbituric acid) tests used to detect incipient rancidity. The project is being continued.

Industrial Utilisation of Fats—Studies at the laboratory on the development of simplified techniques for the synthesis of glycerides of known constitution have been continued and a simplified method for the esterification of fatty acids has been developed. Investigations on the composition of tall oil from the local wood pulp industry have commenced.

The laboratory has assisted with the development of rice bran oil recovery in the Union of Burma, as part of the Colombo Plan. Investigations made by an officer of this laboratory in Rangoon have shown that the project is of great economic value to the Burmese in supplying much needed edible oils. Assistance has been given to the Department of Mines in South Australia in preparing, as requested, oleyl esters of branched chain and oleic acids for the purification of ores by flotation.

RABBIT AND ROOK STUDIES

The distribution and density of rabbits are determined, in part, by the conditions of the habitat. A nine-months' survey of rabbit habitats in New Zealand has been initiated by Dr Walter E. Howard, a Research Fulbright Scholar from the University of California, who is attached to the Animal Ecology Section. The objectives of this project are to analyse in some detail how vegetation, as related to rainfall, land use and soil conditions, may influence the density of rabbit populations. In other words, to determine how rank the herbaceous forage must become before it makes the habitat unsuitable for rabbits. The rabbit boards in their successful campaign against the rabbit have brought its population down to small residual pockets, and the information sought by this project will be of assistance in dealing with these residual populations.

At the request of Federated Farmers, the Animal Ecology Section undertook a study of the distribution and abundance of rooks in New Zealand. These birds were liberated on several occasions between 1869 and 1873, and eventually became established in Hawke's Bay and Canterbury, where they sometimes cause considerable damage to crops growing in the vicinity of the rookeries.

Surveys carried out by the Animal Ecology Section during the 1955 and 1956 nesting seasons revealed the existence of 27 occupied rookeries in Hawke's Bay and 20 near Christchurch. A few rookeries occur in

other districts: one in southern Wairarapa, one or two on Banks Peninsula, and three near Peel Forest in South Canterbury. By studying the dates of establishment of the various rookeries, it was possible to show that the birds are extending their range in both Hawke's Bay and Canterbury. The frequency with which the destruction of an old rookery has been followed by the establishment of several new ones suggests that attempts to control the birds at their rookeries, such as by shooting or cutting down of trees, may be significant in accelerating the spread of the species. Poisoning the birds on their feeding grounds, as carried out recently by the Department of Agriculture, is likely to provide a much better form of control.

The recent surveys of distribution will be useful in allowing documentation of any future changes that may occur in the distribution and abundance of rooks, and such information is important as a means of assessing the effectiveness of control operations. Knowledge of the exact location of the various rookeries, and of the movements of the birds away from the rookeries particularly during the winter, is also necessary for the efficient application of control measures based on the use of poisons.

INFORMATION SERVICES

Information Bureau—The functions of the bureau comprise the editing and publishing of departmental publications, and the maintenance of the Central Library, Technical Information Section, Public Relations Office, Photographic Section, and Translation Section.

Both sections (Agricultural Research and General Research) of the *New Zealand Journal of Science and Technology* have again increased appreciably in size during the year, and prompt publication has been maintained. The *Journal* is, in general, for the publication of articles embodying the results of original scientific research work in practically all branches of pure and applied science. Papers are required to be based on work carried out in New Zealand or on New Zealand material or, in special cases, to have some other connection with New Zealand.

Arrangements are in hand for terminating publication of the *New Zealand Journal of Science and Technology* at the end of this year. It will be replaced by *New Zealand Journal of Agricultural Research, New Zealand Journal of Geology and Geophysics,* and *New Zealand Journal of Science.* In order to accommodate more easily large tables and figures, the page size is to be $9\frac{1}{2} \times 7$ in., compared with the present $9\frac{1}{2} \times 6$ in. The titles of the first two publications are self explanatory; the third will comprise articles not appropriate to either of the others.

During the past twelve months the bureau has edited and published some twenty bulletins and major publications on behalf of the branches of the Department. Additional departmental publications, apart from the *Journal,* handled by the bureau included the annual report and a detailed *List of Publications* comprising the main series of printed publications issued by the Department since its establishment.

A third edition of the *Departmental Handbook* was issued last October. Some two hundred and fifty copies of the *Handbook* were distributed at the Seventh International Grassland Congress at Palmerston North, and one thousand seven hundred at the Thirty-second Meeting of the Australian and New Zealand Association for the Advancement of Science at Dunedin.

The Technical Information Section dealt with some five hundred and fifty major inquiries during the year. Approximately half of these were from manufacturers, and over one-third from Government Departments and local authorities. The Technical Information Officer keeps in close touch with the Scientific Liaison Officer in London, and with the Liaison Secretary in Washington. Collaboration with overseas technical information agencies has been considerably extended and as a result of this a great deal of valuable technical literature has become available to New Zealand inquirers (e.g., the reports issued by the Canadian Technical Information Service and those of the European Productivity Agency in Paris).

The *Industrial Bulletin* is published by this Department and the Department of Industries and Commerce. Approximately two hundred abstracts and scientific and technical articles were contributed by the Technical Information Section during the year, and about three hundred requests were subsequently received for further information on the subjects referred to. Increasing use is being made of the *Industrial Bulletin* by Government Departments.

Scientific Liaison Service—The Department's Scientific Liaison Offices in London and Washington render a most valuable service by keeping the Department advised of recent and important scientific and technical developments overseas. Liaison officers obtain a great deal of valuable information that would not normally reach research workers and industry in the Dominion. The early receipt of this information assists the Department and its officers in formulating and modifying research programmes.

The Scientific Liaison Officer in London, in addition to other duties, represents New Zealand on a number of Commonwealth Scientific Committees, and acts in an advisory capacity in scientific matters to the High Commissioner's Office.

In London and Washington the Department's representatives are associated with liaison officers from other parts of the Commonwealth to form, in each capital, a British Commonwealth of Nations Scientific Liaison Office (B.C.S.O.).

Commonwealth Agriculture Bureax—The Commonwealth Agricultural Bureax (C.A.B.), consisting of ten bureax, three institutes, and a headquarters (all but one of which are located in the United Kingdom), prepare and publish abstracts of and monographs based on the world's scientific literature in the fields of agriculture and forestry. This and the other services of the C.A.B. enable research and extension workers to keep up to date with the rapid developments in these and related subjects.

The organisation is one of the earliest established, and one of the most successful organisations on a Commonwealth-wide basis in the field of science. Commonwealth Governments contribute financially to the support of this organisation and world-wide sale of its publications augments its funds.

New Zealand is represented on the Executive Council by our Scientific Liaison Officer in London. Each bureau or institute is represented in New Zealand by an official correspondent who is a specialist in the subject concerned.

GRANTS TO OTHER INSTITUTIONS

Apart from the incorporated research associations, grants were continued for research in the University (£30,100), and much valuable work is being undertaken. Such grants are closely co-ordinated with those made by the research committee of the University in order to avoid duplication, and ensure the most efficient use of the funds available.

The grant (£10,996) to the Cawthron Institute was continued to enable the institute to maintain its wide range of activities in the Nelson area and to undertake specialist chemical research in co-operation with departmental branches, such as the Tobacco and Hop Research Stations. The grant to the Royal Society of New Zealand was maintained at £4,000 to assist the society to fulfil its role as the senior scientific society in the Dominion, and a special grant of £2,000 provided to enable an accumulation of manuscripts to be printed.

CONCLUSION

The Department has continued to receive generous co-operation from other State Departments, the Cawthron Institute, and the university colleges, overseas scientific organisations, and from both farming and manufacturing interests. The good relations that have prevailed have been much appreciated and have greatly assisted the promotion of the Department's objectives.

In conclusion, I would thank the staff of the Department for their help and co-operation during the year, and also express my personal indebtedness to the Council of Scientific and Industrial Research and its advisory committees for the assistance they have generously rendered on all occasions.

W. M. Hamilton, Secretary.

BRANCHES

ANIMAL ECOLOGY SECTION

Officer in Charge: Dr K. Wodzicki

PROJECTS

Research on Mammals

Rabbits—Investigations of local differences and long-term fluctuations in the breeding and population structure; factors controlling the intensity of parasitic infestations; geographic distribution of rabbit nematodes; census techniques; age determination by the sequence of bone fusion; and investigations on distribution and density of rabbit populations in relation to environmental factors and control operations.

Rats—Distribution and ecology of kiore, or Maori rat, in New Zealand; study of rats in Westland forests in relation to rimu regeneration; and cat-rat-petrel inter-relationships on Little Barrier and Raoul Islands.

Hedgehogs—Investigation in the ecology of the hedgehog.

Research on Birds

Distribution and ecology of rooks in Canterbury and Hawke's Bay; studies on life history, dispersal, and mortality of gannets and blackbirds; and distribution of magpies.

Surveys

Ecological surveys of western Taupo and (in co-operation with the N.Z. Forest Service and Auckland Institute and Museum) of Cameron Mountains, Southland.

PUBLICATIONS

Some Facts and Theories on the Ecology of the Wild Rabbit. *N.Z. Sci. Review. 14*:51–7. P. C. Bull.

The Use of Pellet Counts for Estimating the Density of Populations of the Wild Rabbit, *Oryctolagus cuniculus* (L.). *N.Z. J. Sci. Tech. B38*:236–56. R. H. Taylor and R. M. Williams.

Report of the Ringing Committee for the Year ending March 1956. *Notornis 7*:9–13. P. C. Bull.

Breeding of the House Sparrow Away from Man in New Zealand. *The Emu 56*:146–7. K. Wodzicki.

An Experiment in Rabbit Control (Kourarau Poison Trials). *N.Z. J. Sci. Tech. B38*:389–99. K. Wodzicki and R. H. Taylor.

Reproduction of the Wild Rabbit, *Oryctolagus cuniculus* (L.) in Hawke's Bay, New Zealand. *Ibid. B38*:451–82. J. S. Watson.

APPLIED MATHEMATICS LABORATORY

Director: Dr R. M. Williams

PROJECTS

Linking meteorological data with run-off measurements by time series methods; analysis of soil moisture measurements; analysis of Fourier components of weather data; models of population growth with age-

dependent variables (entomological applications); analysis of lamb-mortality data; analysis of experiments on the most economic use of fertiliser; discrimination between soil types; separation of growth and weather effects; transmission of seismic waves in country containing pumice; ionospheric problems; convection problems for geothermal project; consolidation of soils; mathematical genetics; interpretation of evidence of identification; stochastic processes with periodically varying structure; significance tests for ordered statistics; and continuity corrections for statistical tests.

Design and Analysis of Surveys and Experiments in a Variety of Fields—These include fruit research, microclimatic work of grasslands, educational research, plant breeding, cheese manufacture, corrosion tests, calorific value of coal, dental caries, brick manufacture, numerous experiments in grasslands research, and the use of fertiliser.

PUBLICATIONS

Treatment Variances for Experimental Designs With Serially Correlated Observations. *Biometrika 43*:208–12. J. C. Butcher.

The Behaviour of an Estimator for a Simple Birth and Death Process. *Ibid. 43*:23–31. J. H. Darwin.

The Connection Between Ionospheric Patterns and Field Strengths Reflected on the Ground; *J. Abstr. and Terrest. Phys. 9*:282–94. J. E. Drummond.

Goitrogenic Effect of White Clover. *N.Z. J. Sci. Tech. A38*:88–102. D. S. Flux, G. W. Butler, June M. Johnson, A. C. Glenday, and G. B. Petersen.

The Use of Discriminant Functions in the Selection of Pasture Plants, With Particular Reference to the Lolium Species. *International Grasslands Conf. Palmerston North, Nov. 1956.* A. C. Glenday and S. O. Fejer.

Reseeding Pastures by Oversowing and Overdrilling. *N.Z. J. Sci. Tech. A38*:416–30. M. W. Cross and A. C. Glenday.

A Statistical Design for Fertilizer Experiments on Variable Hill Soils. *Ibid. B38*:112–9. H. S. Roberts and R. B. Miller.

Making a Decision. *Management, Sept. 1956*:31–5. W. B. Taylor.

Incomplete Block Designs With Row Balance and Recovery of Inter-block Information. *Biometrics 13.* W. B. Taylor.

N.Z. Agricultural Sample Survey. *J.R.S.S. A119*:409–24. W. B. Taylor and D. C. Clements.

Extensions to Missing Plot Techniques. *Biometrics,* Sept. 1956:241–4. H. R. Thompson.

On a New Class of Partially Balanced Incomplete Block Designs. *Calcutta Stat. Assn. Bull. 6*:1–3. H. R. Thompson.

Distribution of Distance to the Nth. Neighbour in a Population of Randomly Distributed Individuals. *Ecology 37*:391–4. H. R. Thompson.

The Estimation of Age-specific Infection Rates from a Curve of Relative Infection. *Biometrics 12*:152–62. P. Whittle.

The Use of Pellet Counts for Estimating the Density of Populations of the Wild Rabbit, *Oryctolagus cuniculus* (L). *N.Z. J. Sci. Tech. B38*:236–56. R. H. Taylor and R. M. Williams.

The Variance of the Mean of Systematic Samples. *Biometrika 43*:137–48. R. M. Williams.

The Multivariate Distribution of Complex Normal Variables. *Ibid. 43*:212–5. R. A. Wooding.

Variations of Yield Variance With Plot Size. *Ibid. 43*:337–43. P. Whittle.

In breeding when Homozygates are at a Disadvantage: a Reply. *Heredity. 10*:271–4. B. I. Hayman and Kenneth Mather.

AUCKLAND INDUSTRIAL DEVELOPMENT LABORATORIES

Director: Mr J. B. Brooke

PROJECTS

Medical Instrumentation—Continuing development of bloat-recording equipment; development of improved temperature recorder for body temperatures; investigation of methods of swab-making; design of automatic X-ray isodose computor and recorder; design and construction of improved cardiotachometer; development and construction of differential pressure recorder; modifications to infant respirator; construction of improved oximeter; modifications to animal breathing valve; construction and application of positive/negative pressure anaesthetic machine; design of stainless steel syringes for high-speed angiocardiography; development of intravenous drip rate recorder and controller; development of hydraulic oscillator and its application to calibration of dynamic pressure recording equipment; development and construction of cervical tension indicator; assistance with decompression rate recording in harbour bridge caissons; and specification, calibration and use of infra-red CO_2 analyser in anaesthesia.

Design and Workshop—Tube finning machine for the production of finned radiating tube for refrigeration; design details of cardboard cutting machine; design details of springing system for steel roller doors; general vibration analysis and balancing work for industry; positive and negative phase breathing apparatus; isodose recorder; pitocen drip rate control unit; indwelling aortic valve in "fluon"; design of coal screening unit; gear boxes and timing clocks for International Geophysical Year project; controlling valves for plant humidity cabinet; deep water sampling device in stainless steel; spring tension relieving accumulator for oceanographic work; and seed dusting machines for laboratory use in India.

Electronics and Physics Section—Measurement of sap flow in trees; measurement of ground vibrations during blasting; sound level, temperature, and air flow measurements for industry; calibrations of industrial sub-standards; and assistance in audiometry to the School for the Deaf.

Metallurgy—Survey of N.Z. foundry sands; investigation of bonding properties of N.Z. clays; assistance to foundry industry in Auckland and district; investigation of the physico-chemical properties of N.Z. ironsands; physical testing of materials to N.Z. and B.S.S. specifications; non-destructive testing of components and structures; and investigations of failed components.

Fuel—Regular visits to industrial steam-using installations; advice and assistance on new drier; boiler trial on 100 h.p. unit; information on use of overfire jets; assistance in use of gas analysis equipment; assistance

with combustion problems; determination of calorific values of fuels including black liquors from pulp and paper industry; investigation of grit and smoke problems; screen analyses of coals; and tests on long-term storage and weathering of a Waikato coal.

PUBLICATIONS

An Automatic Breathing Valve. *N.Z. Medical Journal 55*:429–34.
Continuous Intergration of the Foetal Heart Rate. *Ibid. 55*:309–12.
The Characteristics of Parallel-T R.C. Networks. *Electronic Engineering* Feb. 1957.
A Foetal Pulse Recorder. Electronic Engineering. Mar. 1957. 132–5.

BOTANY DIVISION

Director: Mr C. M. Smith

PROJECTS

Revision of the *Manual of N.Z. Flora;* preparation of *Flora of Adventive Plants in N.Z.;* preparation of monograph of N.Z. graminaceous plants; preparation of chromosome atlas of N.Z. indigenous plants (report on chromosome behaviour in N.Z. gymnospermous genera, and report on chromosome behaviour of N.Z. Violaceae); breeding and ecology of local forms of indigenous species of the genera *Agropyron, Festuca,* and *Danthonia;* and ecology of South Island tussock grasslands (vegetational changes in progress at Molesworth).

Maintenance and Upkeep of Herbaria: herbarium of indigenous plants; herbarium of adventive and cultivated plants; and seed herbarium.

Collection and distribution of seeds of indigenous plants and annual issue of an Index Seminum; recording of introductions of seeds from overseas for scientific and commercial purposes; establishment in Canterbury of a botanic gardens for the conduct of the Division's observations and experimental work, and for maintenance of a reference collection of growing plant material; study of New Zealand freshwater plants and their distribution.

Palynology: pollen morphology and anatomy of native species of Podocarpaceae and Myrtaceae, and pollen analysis of peat deposits of Auckland Island and of local peat strata; and a report on the Auckland Island deposits is now near to completion.

PUBLICATIONS

Interspecific Hybrids in New Zealand *Agropyron. Evolution 10*:415–20 H. E. Connor.
Subsexual Reproduction in *Agropyron. Heredity 10*:129–60. J. B. Hair.
Branch Abscission and Disintegration of the Female Cones of *Agathis australis Salisb. Phytomorphology 6*:151–67. Mrs. R. Licitis-Lindbergs.
A Checklist of New Zealand Charophyta. *Trans. Royal Soc. N.Z. 84*:269–71. Ruth Mason.
Seedling Studies in Fescue-tussock Grassland.
II. Performance in Four Sites. *N.Z. J Sci. Tech. A38*:512–26. Margaret J. A. Simpson.
Changed and Changing Vegetation. *Science in New Zealand.* A. H. and A. W. Reed (Wellington). C. M. Smith.

CROP RESEARCH DIVISION

Director: Dr. E. J. Godley

FIELD-CROP PROJECTS

Wheat Breeding—A general-purpose wheat of Cross 7 type with higher yields; an early maturing variety that will not lodge, to replace Tainui in the North Island; a high-yielding wheat with stiff straw and tight chaff for high-fertility land where Dreadnought is grown; a high-quality wheat with higher yields than Hilgendorf; lines of commercial varieties resistant to mildew; and spring wheat suitable for mid-Canterbury.

Wheat Genetics Studies—Inheritance of kernel weight, grain-shattering, protein, mildew-resistance, and purple grain colour.

Wheat Disease Survey—Annual surveys, for five years, of a representative sample of Canterbury wheat crops.

Oat Breeding—Lodging-resistant milling oats; lines of commercial varieties resistant to crown rust; and introduction and testing of promising overseas varieties.

Barley—Work confined to the introduction and testing of new overseas varieties.

Potato Breeding—Resistance to blight *(Phytophthora infestans)*, scab, and pink rot (*P. erythroseptica*); resistance to viruses X, Y, and leafroll; and improved agronomic characters.

Virus-free Stocks of Potatoes—Selection of virus-free plants of commercial varieties and maintenance of nucleus stocks; and annual testing of virus-free stocks that are being increased by the Department of Agriculture.

Potato Virus Diseases—Study of the natural spread of virus diseases; study of strains of viruses X and Y; methods of eliminating virus from infected stocks; methods of testing for virus content and virus resistance; study of the nature of resistance and of gene action; and the effect of environment upon resistance.

Potato Blight—Study of blight strains in New Zealand and of their origin; study of the nature of resistance and of gene action; and the effect of environment upon resistance.

Swedes—Breeding for resistance to dry rot and resistance to club root.

Rape—Breeding for resistance to aphids and for improved agronomic type of club-root resistant rape.

Turnips—Breeding for club-root resistant green globe type.

Lucerne—Investigation of factors that determine when different lucerne varieties commence growth in the spring; selection of uniform early strain of lucerne with good agronomic characters; breeding lucerne that combines earliness with high summer production; selection of lucerne capable of growing during drought periods; breeding creeping rooted lucernes with high productivity and extended growing season; and testing lucerne varieties offered for sale in New Zealand, and of varieties likely to be offered for sale in New Zealand.

Lupins—Breeding of yellow and blue lupins for rapid early growth, low alkaloid content, high seed production, and non-shattering pods.

Linseed and Linen Flax—Breeding and selection of linseed and linen flax for resistance to rust.

VEGETABLE PROJECTS

Cabbage and Cauliflower—Selection for uniform and non-bolting Flower of Spring cabbage; and uniform strain of 5-months cauliflower.

Disease Resistance—Club root in vegetable Brassicas; spotted wilt in tomatoes; Cladosporium in glasshouse tomatoes; white rot in onions; rust in beans; and wilt and mosaic resistance in peas.

Nucleus Seed—Sweet Crop carrot, Best of All and Omega cabbage, wilt-resistant Greenfeast peas, and shiny Fardenlosa beans.

Kumara—Formation of a collection of true Maori varieties.

NUCLEUS SEED PRODUCTION

Each year pure seed of some forty crop varieties is produced to provide nucleus seed for the seed certification scheme of the Department of Agriculture.

AGRONOMY PROJECTS

Forage crop measurement techniques suitable for lamb fattening crops and cereal greenfeeds; digestibility determinations of Borre lupin, of rape, and of soft turnips alone and in mixtures; lamb-grazing and weight-gain experiments to measure the improved lamb meat yield expected from the 30 per cent average higher dry matter yield of a mixture of rape and Borre lupin over that of rape alone; simple mixtures of legume forages to increase dry matter (cereal greenfeeds and regrazable legumes, rape and Borre lupin, and soft turnips and lupin); the part played by underground transfer of nitrogen on yield of leguminous and non-leguminous forage crops; cereal greenfeed variety, species, and seed rate trials; effect of numbers of cuts, intervals between cuts and height of cut on the yield, and food value of cereal greenfeeds sown at two times; the factors influencing recovery or death of cereal greenfeeds (response to different kinds, amounts, and times of application of nitrogenous fertilisers); improvement of forage and seed yield of C.R.D. ryecorn, and seed increase of improved lines; the effect of times and rate of soil and spray application of urea on yield and baking quality of wheat; effect of leaf rust on yield and food value of cereal greenfeeds and animal production; effect of different levels of soil moisture and applied nitrogen on the yield and food value of rape varieties; the residual effect of irrigation, nitrogen, and rape varieties on yield of short rotation rye-grass; and testing suitability of species and varieties for different regions by means of different levels of soil moisture and nitrogen.

PLANT PHYSIOLOGY

An investigation of experimental techniques for extraction, separation, and assay of growth substances; factors causing abscission of flowers and fruits in yellow lupins; and the capacity of various crop plants to utilise available and fixed phosphates in pumice soils.

PLANT BIOCHEMISTRY

Nitrogen Fixation—An investigation of the significance of peptides containing glutamic acid in cultures of *Azotobacter vinelandii.*

Disease Resistance—The composition of the soluble nitrogen fractions of the leaves from rape and swede varieties that are resistant and susceptible to aphid attack; and a more detailed investigation of the effect of virus infection upon the soluble nitrogenous components of potato tubers.

General Plant Metabolism—The change in metabolic activity of the rape plant with age, especially with respect to the problems of maturity, and insect resistance; and the comparative synthesis of protein in high and low baking quality wheats.

Crop Utilisation—Digestibility trials on single and combined fodders, e.g., rape and lupins; and analyses of feed constituents in Brassicae, greenfeeds, and lupins.

PUBLICATIONS

A Small-scale Quality Test in Wheat Breeding. *Nature 177*:756–7. L. G. Copp.

Arawa, a New Wheat to Replace Dreadnought. *N.Z. J. Agric., 93*:221–5. L. G. Copp and W. R. Lobb.

Improved N.I.A.B. Ryecorn. *Ibid. 92*:421–4. A. F. Greenall.

Trials Suggest That Rape and Borre Lupin Mixtures Fatten Lambs Better Than Rape Alone. *Ibid. 93*:257–60. A. F. Greenall.

Resistance of Swedes to Aphids.

II Distribution of Aphids on Swedes. *N.Z. J. Sci. Tech. A38*:30–3. T. P. Palmer.

A New Carrot Variety for the Home Gardener. *N.Z. J. Agric. 53*:489–90. W. G. Priestley.

Heat Treatment and Tissue Culture as a Means of Freeing Potatoes from Virus Y. *Nature 177*:709. A. D. Thomson.

Studies on the Effect of Malachite Green on Potato Viruses X and Y. *Aust. J. Agric. Res. 7*:428–34. A. D. Thomson.

Definition of Potato Virus X Strains Present in New Zealand Potato Varieties. *Ibid. 7*:527–35. A. D. Thomson.

Elimination of Potato Virus Y from a Potato Variety. *N.Z. J. Sci. Tech. A38*:482–90. A. D. Thomson.

Borre, a New Sweet Blue Lupin Variety. *N.Z. J. Agric. 93*:215–6. R. F. M. Van Steveninck.

The Occurrence of Funnel Leaflets and Ring Fasciations in Yellow Lupins. *Annals of Botany 20 (79)*:385–92. R. F. M. Van Steveninck.

Selection for Disease Resistance in Linseed. *N.Z. J. Sci. Tech. A38*:239–47. R. F. M. Van Steveninck and I. A. M. Cruickshank.

Missing Values in Factorial Experiments. *Nature 178*:1481. G. M. Wright.

Nitrogen and Amylase in Some New Zealand Barleys. *Inst. of Brewing J. 62*:470–7. R. Stern and G. M. Wright.

The Inheritance of Immunity to Pea Mosaic Virus. *Aust. J. Agric. Research 7*:272–80. D. E. Yen and P. R. Fry.

The Selection of Cabbage Strains for N.Z. Conditions. *N.Z. Commercial Grower 12(5)*:1–5. D. E. Yen and W. G. Priestley.

Wilt-resistant Greenfeast Peas. *N.Z. J. Agric. 94*:149. D. E. Yen and I. A. M. Cruickshank.

What is the Effect of Rust on Cereal Forage Crops? *Commonwealth Phytopathological News 2*:62. A. F. Greenall.

DOMINION LABORATORY

Director: Mr F. J. T. Grigg

PROJECTS

Physical Chemistry—Vapour pressure of sea water, heat of wetting of wool, physical properties of glass, infra-red spectrophotometry, spontaneous combustion, and identification of barbiturates.

Metallurgy—Corrosion in geothermal steam, intergranular corrosion of duralumin, properties of foundry sands, fatigue in alternator windings, and accidents in top-dressing aircraft.

Minerals—Drilling muds, pozzolanic materials for concrete, colorimetric rock analysis, hexavalent chromium in cement and the use of chrome-lignin grout, and geochemical prospecting for uranium.

Petroleum and Road Materials—Examination of oils and petroleum products, corrosion by de-icing fluid, and examination of road binder materials.

Chemical Engineering—Separation of water from geothermal steam, two-phase flow, dehydration of food, smoking of bacon, combustion of coal under boilers, gasification of coal, and mineral dressing.

Geothermal—Gas content of Wairakei steam, chemical methods of determining steam/water ratio of bore discharge, and sampling and analysis of White Island fumaroles.

Coal—Moisture in coal, boron in coal ash, development of sample divider, analyses of coals and gases, combustion and gasification of coal, and gas testing.

Organic—Pesticide residues on fruit, fungicidal effect of spray particle size, arsenic in wood smoke, foaming of *Pinus radiata*, composition of wood extractives, DDT in lambs livers, and forensic and toxicological investigations.

Paint—Underwater paints for hydro-electric installations, metal protective paints for geothermal steam, paint durability on Tawa and *Pinus radiata*, painting of concrete and of structural steel, and black stains on house paint.

Food and Drugs—Bacteriology of dairy products, examination of purity of food and drugs, analysis of waters, and identification and estimation of preservatives in food.

Meat—Structure of myosin, muscle chemistry, rigor mortis in lamb, bone taint in beef, and meat dehydration.

PUBLICATIONS

Clay Mineralogy of New Zealand Soils.

Part 3, Infrared Absorption Spectra of Soil Clays. *N.Z. J. Sci. Tech. B38*:31–43. M. Fieldes, I. K. Walker, and P. P. Williams.

Solubility of Some Mixtures of Alkali Borates. *I.E.C. Chem. and Eng. Data Series 1*:95–9. H. P. Rothbaum, H. J. Todd, and I. K. Walker.

Corrosion in New Zealand. *N.Z. Engineering 11*:368. T. Marshall.

Microdetermination of 2-(p-*tert*-Butylphenoxy)-1-methylethyl 2-chloroethyl Sulphite (Aramite) Residues by Sulphur Dioxide Evolution. *J. Agri. and Food Chem. 4*:452-4. C. C. Watson.

Absorption Spectrum of p-chlorobenzyl-p-chlorophenyl Sulphide (Chlorbenside). *Chem. and Ind. (1956)*:349. C. C. Watson.

Parathion Spray Residue on Apples, Beans, and Quinces. *N.Z. J. Sci. Tech. B37*:623–5. Helen E. Barr, P. J. Clark, and H. Jacks.

The Schradan Content of Fruit and Vegetables. *Ibid. B38*:58–65. P. J. Clark and H. Jacks.

Extractives of *Larix decidua* and *Larix leptolepis*. *Ibid. B37*:626–32. H. V. Brewerton.

Note on the Distribution of Ether-soluble Resin in *Pinus Radiata* D. Don. *Ibid. B37*:633–4. I. R. C. McDonald, H. V. Brewerton, and Phyllis M. Ashwin.

Bacteriological Survey of Auckland Harbours.

Part 4. Manukau Harbour. *Ibid. B37*:663–70. G. M. Wallace, L. E. Newman, and Jacqueline L. Jerrome.

The Connective-tissue Content and Toughness of Sheep Muscles. *J. Sci. Food Agric. 7*:51–6. P. M. Nottingham.

The Dissociation of Myosin by Heat Coagulation. *Biochim. Biophys. Acta 20*:514. R. H. Locker.

Bone Taint in Beef. *J. Sci. Food Agric. 7*:546–51. Lorna S. Cosnett, D. J. Hogan, N. H. Law, and B. B. Marsh.

A Simple Rotary Film Evaporator. *J. Sci. Instru. 33*:446–7. B. B. Marsh and P. M. Nottingham.

The Determination of Copper Using the Silver Reductor. *Analytica Chimica Acta. 15*:12–14. W. J. Wilson.

An Investigation into the Manufacture of Fused Calcium-magnesium Phosphate Fertiliser in New Zealand. *N.Z. Dep. sci. industr. Res. Bull.:119* W. M. Billinghurst and D. S. Nicholson.

A User's Directory of New Zealand Coals. *N.Z. Dep. sci. industr. Res. Inf. Ser.:10.* J .O. Elphick.

Determination of Tetramethyl Thiuram Disulphide and Dimethyldithiocarbamate Spray Residues on Apples. *N.Z. J. Sci. Tech. B38*:425–32. Helen E. Barr, P. J. Clark, and H. Jacks.

Determination of Magnesium in Plant Ash. *Ibid. B38*:447–50. Phyllis M. Ashwin and J. A. Ritchie.

Quantitative Infra-red Analyses of Mixtures of Isomeric or Closely Related Substances. Mixtures of Chlorinated Insecticides. *Anal. Chem. 29*:339–46. I. R. C. McDonald and C. C. Watson.

Cyclic Electrolysis, Part 1. *Trans. Inst. Met. Finishing. 34*:53–66. A. Hickling and H. P. Rothbaum.

Chemical Engineering. *Science in New Zealand*:256–61. A. H. and A. W. Reed (Wellington). G. Maskill-Smith.

DOMINION PHYSICAL LABORATORY

Director: Mr W. H. Ward

PROJECTS

Physics of the Thermal Area—A comparison of well-developed and underdeveloped areas by a thermal survey at Wairakei and Waiotapu, and an investigation of thermal conditions before flooding at Orakei Korako; field trials and organisation for routine use of a rapid method of preliminary survey; theoretical studies of temperature/time relations near bores; development of instruments for measuring very slow rates of

flow through saturated soil; and establishment of laboratory models for comparison with theoretical studies of heat flow through saturated ground.

Heat Research—The firmer establishment of thermal conductivity measurements; general advice on thermal insulation and heat problems; and the development of field methods for the thermal conductivity of ground.

Microclimatology—Measurement of mechanical properties of plants and the investigation of the relationship between these properties and the plant's environment; investigation of the moisture movement through a soil caused by thermal gradients; setting up plant cabinets to provide adjustable controlled environments for growing plants; development of equipment for the measurement of the amount of heat and water vapour carried vertically by atmospheric turbulence; measurement of the transpiration rate of plants under different soil moisture conditions and in different environments; and investigation of how evaporation over a pasture is influenced by pasture length.

Isotope Research—Sulphur isotopic survey; radium-D-radon measurements; ^{14}C age measurements; $^{13}C/^{12}C$ variations in nature; ^{14}C variations in nature; carbon isotope exchange rates; radioactive grout and well-logging; nitrogen isotopic measurements; making deuterium mass spectrometer; maintenance and improvements to mass spectrometer; source of radioactivity in New Zealand soils; high temperature Geiger-Muller tubes; bore output measurements at Wairakei; high temperature nuclear furnace; ionisation levels of carbon dioxide; correlation of cosmic-ray components with ^{14}C background; the use of tritium as a tracer; a cobalt-60 source of radiation; radioactive fallout; assembly of equipment for radiation research; and excitation energy transfer.

Electron Microscopy—Further work on human teeth; wear of sheeps' teeth; distortions in microtomy; various studies for Plant Diseases Division; motility of spermatozoa; and improvement of electron microscope.

Engineering Seismology—Use of analogue computer to check the earthquake-resistant design of a 20-storey building for the Auckland City Council; further development of the analogue computer to allow for the effect of yield in a building when subjected to an earthquake; investigation of computer for bearing-wall buildings; maintenance and collection of records from a chain of strong-motion seismographs that give data on earthquakes of engineering value; and instrumentation of a building to record actual stresses and accelerations experienced during an earthquake.

Radio Research—The use of a frequency standard in the investigation of long-distance ionospheric propagation; study of sea echo beyond the horizon; application of coherent detection; propagation of centimetre waves almost tangential to a sea surface, and the application of geometrical optics to this project; measurement of ionospheric winds; measurement of radio "whistlers"; development of radar sets for observations of aurorae during the International Geophysical Year; and development of apparatus for observing radio propagation in the Southern Auroral Zone during the International Geophysical Year.

General—Development of an electronic correlator; use of prototype plant for making weatherproof transformers; calibration of testing machines for Government Departments, local authorities, technical and university colleges, and industry; checking of gauges used by Army

Department for small arms ammunition; tests (mainly electrical) to encourage improved quality in New Zealand commodities; and calibration of audiometers, thermometers, anemometers, and electrical instruments.

Optical Design—Simplification of some theory of geometrical optics; development of aspheric lenses.

Standards—Establishment of standards of physical measurement in length, mass, force, temperature, pressure, photometry, radiation, and air velocity; maintenance of standards of electrical quantities; development of current and voltage transformer testing; development of methods of measurement at radio frequencies; and establishment and emission of standards of frequency.

PUBLICATIONS

Rate of Heat Production by Bull Spermatozoa. *Nature 178*:933. S. Bertaud and M. C. Probine.

The Band Structure of Bismuth. *Phys. Soc. Proc. A69*:513–9. V. Heine.

The De Haas van Alphen Effect in Alloys. *Ibid. A69*:505–12. V. Heine.

A Scatter Diagram Which Gives the Complex Correlation Coefficient for Normal Variables. *N.Z. Sci. J. Tech. B38*:366–74. N. F. Barber.

The Eccentric Loading of Optical Flats During Grinding. *J. Sci. Insts. 34*:36. N. F. Barber.

The Eccentric Loading of Optical Flats During Grinding. *Ibid. 34*:36. N J. Rumsey.

What is Accuracy? *N.Z. Sci. Rev. 14*:83–7. W. H. Ward.

Time Signals for the Determination of Longitude. *Inst. Rad. Engr. Proc. 44*:1064–5. W. H. Ward.

Design and Construction of Equipment for the Comparison of Standard Cells. *N.Z. Elect. J. 29*:321–3. J. H. Harvey.

Heating Requirements for Domestic Buildings. *N.Z. Engg. 11*:195–7. L Bastings.

The Simultaneous Occurrence of "Dawn Chorus" at Places 600 km. Apart. *Nature 178*:937–8. G. McK. Allcock and L. H. Martin.

Harmonics in a Multi-storey Structure. *Ibid. 178*:36–7. M. J. Murphy, G. N. Bycroft, and L. W. Harrison.

The Response of a Non-linear Oscillator to an Earthquake. *Seis. Soc. Am. Bull. 46*:57–65. M. J. Murphy and G. N. Bycroft.

Electrical Analog for Earthquake Shear Stresses in a Multi-storey Building. *World Conf. on Earthquake Engg., California, June 1956. Proc. Section 9*. M. J. Murphy, G. N. Bycroft, and L. W. Harrison.

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Validity of the Envelope Approximation to the Amplitude Distribution of a Random Noise Signal. *N.Z. J. Sci. Tech. B37*:689–99. R. A. Wooding.

The Multivariate Distribution of Complex Normal Variables. *Biometrica 43*:212–5. R. A. Wooding.

Further Electron Microscope Studies of Dentine. *Oral Surg. Oral Med. Oral Path. 9*:432–43. F. R. Shroff, K. I. Williamson, W. S. Betaud, and D. M. Hall.

The Determination of the Horizontal Velocity of Ionospheric Movements from Fading Records from Spaced Receivers. *J. Atmos. Terr. Phys. 8*:163–8. D. W. G. Chappell and C. L. Henderson.

Transpiration from Plants with a Limited Water Supply. *Australia-UNESCO Sympos. on Arid Zone Climatology, Canberra, 1956*:Paper 19. R. L. Closs.

Penman's Method for Estimating Soil Moisture from Evaporation. Proc. Conf. Soil Moisture, held at Dom. Phys. Lab., Sept. 1954. *N.Z. Dept. sci industr. Res. Inf. Ser. 12*:132–47. R. L. Closs.

The Connection Between Ionospheric Patterns and Field Strengths Reflected on the Ground. *J. Atmos. Terr. Phys. 9*:282–94. J. E. Drummond.

The Design of Low Frequency High-pass RC Filters. *Electron. Engg. 28*:254–6. D. D. Crombie.

Selective Admittance-measuring Set for Use at Medium Frequencies. *Electron. Rad. Engr. 34*:11–5. D. D. Crombie.

A Determination of Ionospheric Winds for a 24-hour Period. *J. Atmos. Terr. Phys. 8*:169–70. G. W. G. Court and E. S. Gilfillan.

Microwave Vehicle-speed Indicator. *Wireless Engr. 33*:66–74. G. W. G. Court.

Dew as a Factor in Plant-water Balance. Proc. Conf. Soil Moisture, held Dom. Phys. Lab. Sept. 1954. *N.Z. Dept. sci. industr. Res. Inf. Ser. 12*:66–72. R. L. Jones.

Wide-band Noise Sources Using Cylindrical Gas-discharge Tubes in Two-conductor Lines. *Inst. Elect. Engrs. Proc. B103*:491–6. R. I. Skinner.

Spraypak: A New Industrial Distillation and Absorption Tower Packing. *Inst. Chem. Engrs. Trans. 34*:17–43. J. A. McWilliams.

The Prediction of Maximum Usable Frequencies for Radio Communication Over a Transequatorial Path. *Inst. Elec. Engrs. Proc. B103*: 547–52. G. McK. Allcock.

Correlation and Phase Methods of Direction Finding. *N.Z. J. Sci. Tech. B38*:416–24. N. F. Barber.

Correlation Treatment of Fading Signals. *J. Atmos. Terr. Phys. 8*:318–30. N. F. Barber.

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Differential Correction of Wave-front Aberrations. *Conf. Contemporary Optics, Sydney, Sept. 1956*. N. J. Rumsey.

The New Zealand Thermal Area and its Development for Power Production. *A.S.M.E. Trans. 79*:255–68. C. J. Banwell.

Flow Sampling and Discharge Measurement in Geothermal Bores. *Ibid. 79*:269–78. C. J. Banwell.

Report on Installations of Domestic Space-heating Stoves Burning Solid Fuel. *N.Z. Standards Inst. Report MP1*. L. Bastings.

Long-path V.L.F. Frequency Variations associated with the solar flare of 23 February 1956. *J. Atmos. Terr. Phys. 10*:110–3. A. H. Allan, D. D. Crombie, W. A. Penton.

A Method of Heating Matter of Low Density to Temperatures in the Range 10^5 to 10^6 K. *Aust. J. Phys. 10*:221–5. F. B. Knox.

Recent Developments in Permanent Materials for Housing. *J. N.Z. Inst. Arch. 24*:41–6. L. Bastings and J. Clelland.

Cracking in Concrete Block Structures. *Ibid.* 23 (5):122–3. L. Bastings.

ENTOMOLOGY DIVISION

Director: Dr W. Cottier

MAIN PROJECTS

Grassgrub and *Oxycanus* investigations; insects associated with *Leptospermum* species; clover case-bearer and its control; maintenance and development of insect reference collection; insect survey; identification service and advice concerning the control of insect pests; aphis control in cruciferous crops; wheat stem weevil in ryegrasses; virus control of white butterfly larvae; biological control of crucifer pests; insect pests of Cook Islands (mainly of citrus); systematic study of larval Lepidoptera; biological control of oak leaf-miner; biological control of flies; development of forecasting scheme for orchard insect pests (in co-operation with Department of Agriculture); and systematics of scale insects of the genus *Eriococcus*.

OTHER PROJECTS

Breeding and distribution of egg parasites of green vegetable bug; study of apple leaf-curling midge and its parasites; insect and plant parasitic nematodes; systematics of larval Melolonthinae; systematics of aphids, scale insects in general, of Melolonthinae and Thynninae; and cataloguing of all New Zealand biological control work.

PUBLICATIONS

Grass-grub Control. The Grass-grub Problem. *Proc. Ann. Mtg. Dairyfrms. 1956*:89–91. J. M. Kelsey.

Combating Armyworm With Chemicals. *N.Z. J. Agric. 92*:377–8. A. D. Lowe.

Insecticides Applied to Crops in Flower Can Poison Bees. *Ibid. 93*:229–30. A. D. Lowe.

Control of Brassica Seed Crop Aphides. *Ibid. 93*:256. A. D. Lowe.

Recommendations for Control of Insect Pests on Brassica Crops in New Zealand. *Ibid. 93*:341–53. A. D. Lowe.

Plant Protection in New Zealand. *Tech. Corr. School, Dept. of Education,* Government Printer (Wellington), 699 pp.:209–481. W. Cottier.

Bibliography of New Zealand Entomology. *N.Z. Dept. sci. industr. Res. Bull. 120*:xxiv, 429. D. Miller.

FATS RESEARCH LABORATORY

Director: Dr F. B. Shorland

PROJECTS

General Investigations on the Composition of Animal Fats With Special Reference to Those of Meat and Butter—Isolation and identification of minor constituents including branched-chain fatty acids, *n*-odd-numbered carbon fatty acids, and unsaturated fatty acids; glyceride structure and variations in the fatty acid composition of animal fats in different tissues and at different stages of growth.

Fat Metabolism in Ruminants—The effect of the rumen on dietary unsaturated fatty acids; the relationship between the dietary and depot fats of ruminants; the use of labelled intermediates to determine the

origin of *n*-odd-numbered and branched-chain fatty acids in milk and depot fats of ruminants; the *trans* unsaturated acid content of faecal lipids of ruminants and non-ruminants.

Nutritional Significance and Fate of Minor Constituents of Dietary Animal Fats—Aspects of this general problem being studied in association with the Nutrition Research Department of the Medical Research Council include: relationship between certain lipid constituents, such as branched-chain fatty acids, cholesterol deposition and atherosclerosis; fate of branched-chain fatty acids in the body.

Nature of Phospholipids in Animal Products—The preparation of pure phospholipid fractions from meat and milk products to determine their composition and their role in keeping properties and quality of these products.

Rancidity in Animal Fats—Nature of the compounds responsible for the Kreis and Thiobarbituric acid tests used to detect incipient rancidity.

Industrial Utilisation of Fats and Fatty Oils—Composition of tall oil from the New Zealand paper industry with a view to its utilisation; modification of the properties of animal fats to widen their usage; development of methods for syntheses of triglycerides of known constitution; recovery of rice bran oil in Burma as part of the Colombo Plan.

Development of New Techniques for the Investigation of Fats—Application of gas-liquid partition chromatography to the study of fatty acid composition, using improved methods of detection and estimation; and simplified methods for the preparation of methyl esters.

PUBLICATIONS

New Trends in Fats Research (Liversidge Lecture at 1955 A.N.Z.A.A.S. Meeting, Melbourne). *Aust. J. Sci. 18*:49–62. F. B. Shorland.

Chemistry of the Lipids. *Ann. Rev. Biochem. 25*:101–22. F. B. Shorland.

Branched-chain Fatty Acids. *Aust. J. Sci. 19*:1–6. F. B. Shorland.

Advances in Methods of Peroxide Estimation in Fats. *J. N.Z. Inst. Chem, 20*:132–6. L Hartman.

The Volatile Fatty Acids of Bovine Muscle and Liver Phospholipids. *Biochem. J. 64*:311–8. J. C. Hawke.

The Branched-chain Fatty Acids of Mutton Fat.

3. The Isolation of 16-Methylheptadecanoic Acid (*Iso*stearic Acid). *Ibid. 64*:214–6. R. P. Hansen, F. B. Shorland, and N. June Cooke.

The Occurrence of 14-Methylpentadecanoic Acid. (*Iso*palmitic Acid) in Hydrogenated Mutton Fat. *Chem. and Ind. (1956)*:1149. R. P. Hansen, F. B. Shorland, and N. June Cooke.

Octadecadienoic Acids of Lamb Caul Fat. *Nature 178*:646. R. O. Weenink.

The Isolation of *Iso*- and (+)-*Anteiso*-fatty Acids of the C15 and C17 Series from Shark (*Galeorhinus Australis* Macleay) Liver Oil. *Biochem. J. 64*:461–4. Isobel M. Morice and F. B. Shorland.

Methanolysis of Triglycerides. *J. Amer. Oil Chem. Soc. 33*:129. L. Hartman.

The Metabolism in the Rat of the Naturally Occurring (+)-14-Methylhexadecanoic Acid. *Biochem. J. 65*:438–40. M. Livingstone, M. E. Bell, F. B. Shorland, T. Gerson, and R. P. Hansen.

Optical Activity of Homologous Series. *Nature 179*:310. T. Gerson.

The Occurrence of *n*-Heptadecanoic (Margaric Acid) in Unhydrogenated Mutton Fat. *Biochem. J. 65*:18–20. R. P. Hansen, F. B. Shorland, N. June Cooke.

The Occurrence of *Trans*-unsaturated Acids in Horse Faeces. *Nature 178*:1057–8. L. Hartman, F. B. Shorland, and R. J. Moir.

The Volatile Fatty Acids of Mutton Fat. *Biochem. J. 63*:702–4. A. G. McInnes, R. P. Hansen, and A. S. Jessop.

Animal Fats and Disease – Their Significance in the Light of Recent Investigations. *Food Manufacture 31*:272–6. F. B. Shorland.

The Occurrence in Butterfat of *n*-Heptadecanoic Acid (Margaric Acid). *Nature 179*:98. R. P. Hansen, F. B. Shorland, and N. June Cooke.

Studies on the Composition of New Zealand Butterfat. *XIVth. International Dairy Congress, Rome, Subject 2, Section II.* F. B. Shorland and R. P. Hansen.

The Branched-chain Fatty Acids of Butterfat.

6. Further Investigations on the C15 Saturated Acids. *Biochem. J. 59*:350–2. F. B. Shorland, T. Gerson, and R. P. Hansen.

High Vacuum Jet Systems for Condensation Pumps. *J. Sci. Instruments. 26*:303–4. J. S. George.

FRUIT RESEARCH STATION

Director: Mr J. D. Atkinson

PROJECTS

Variety Testing—Trials include some seven hundred imported apple varieties, small blocks of promising local seedlings of peach, plum, feijoa, and Chinese gooseberry, and a small number of imported apricots, citrus, peaches, and sub-tropical fruits.

Rootstock Testing—Long-term trials of selected apple stocks worked with five scion varieties; plum stocks budded with three varieties; citrus stocks worked with four varieties; and pear stocks budded with one variety. A search for *Phytophthora* resistance in apple stocks is continuing.

Citrus Breeding—Objectives are the production of improved lemons, citrus hybrids suitable for local conditions, and nucellar seedlings of successful citrus varieties free from virus infection.

Strawberry Breeding—The objective is to breed resistance to virus and root rot into a strawberry with the desirable characteristics of the Captain Cook variety.

Fruit Descriptions—Formal description and classification of apples and Japanese plums peculiar to New Zealand.

Application of Hormones to Horticulture—Annual certification lists of tomato setting and anti-fruit-drop hormones; early ripening of stone fruits; and pre-harvest drop of grape fruit.

Chemical Thinning—Apples: effect of reduced concentrations of thinning agents in presence of wetting agents and reactions of treated fruit in cool store; long-term effects of chemical thinning on biennial bearing; and studies on cell size of treated fruits. Stone fruit: attempts to thin peaches chemically.

Orchard Management—Effects of grassing down on tree growth and yield; and studies of contour planting on rolling country.

Tree Nutrition—Effects of heavy top-dressing on apple yields; foliar application of fertilisers; and effect of urea on fruit set.

Tree Metabolism—Identification of nitrogenous compounds in xylem sap of fruit trees, and quantitative determination of amino acids; and changes induced in apple leaves by application of urea.

Apple and Pear Storage—New methods of scald control with emphasis on dip treatments; orchard factors affecting storage quality, including fertiliser treatment, chemical thinning, pomological variations within varieties; effect of case liners on wilting; and studies on variation in maturity of fruit from different parts of the tree.

Biochemistry of Apple Fruit—Studies on the biochemical factors affecting storage quality of apples with emphasis on the role of nitrogen; attempts to alter cell size in developing fruit; and development of a rapid method of measuring cell size.

Virus Diseases—In co-operation with Plant Diseases Division, identification of virus diseases in tree fruits; effects of such diseases on growth and yield; cross protection effects; indexing of budwood trees; and methods of raising virus free trees.

Frost—Measurement of temperatures dangerous to cherries and peaches.

PUBLICATIONS

Science in the Fruit Industry. *Science in New Zealand* 164–75. A. H. and A. W. Reed (Wellington). J. D. Atkinson.

Unusual Features of Some New Zealand Fruit Tree Viruses. *T. Pl. ziekten 62*:39–42. J. D. Atkinson.

Wind-machine Tested at Alexandra. *Orchardist of N.Z. 29 (5)*:25, 27. 1956. J. D. Atkinson and J. E. Hawkins.

Plant Protection in New Zealand. 699 pp. Government Printer. J. D. Atkinson, R. M. Brien, E. E. Chamberlain, W. Cottier, J. M. Dingley, H Jacks, W. D. Reid, and G. G. Taylor.

Willow Leaf of Plums. *Orchardist of N.Z. 30 (1)*:2–3 1957. J. D. Atkinson, E. E. Chamberlain, and J. A. Hunter.

Certification of Therapeutants and Plant Hormones. *N.Z. Dept. sci. industr. Res. Inf. Ser. 13*. G. H. Cunningham and J. D. Atkinson.

Effect of a Permanent Grass Cover on Apple-tree Yield in the First Years After Grassing. *N.Z. J. Sci. Tech. A38*:527–32. E. G. Bollard.

Effect of Steam-sterilised Soil on Growth of Replant Apple Trees. *Ibid. A38*:412–5. E. G. Bollard.

Nitrogenous Compounds in Plant Xylem Sap. *Nature 178*:1189–90. E. G. Bollard.

Effect of Various Growth-regulating Substances on Fruit Drop and Storage Life of Apples. *N.Z. J. Sci. Tech. A38*:45–51. R. M. Davison.

The Use of Chemical Thinning Sprays on Apple Trees in New Zealand.
III. Effect on Fruit Storage Life. *Ibid. A38*:34–40. R. M. Davison.
IV. Compatibility of Growth Substances With Therapeutant Sprays. *Ibid. A38*:41–4. R. M. Davison.

Trials of Fruit-setting Sprays on Glasshouse Tomatoes. *Ibid. A38*:544–7. R. M. Davison.

Effect of Hormone Sprays on Hastening Maturity, Yield, and Size of Apricots. *Orchardist of N.Z. 29 (10)*:29, 31. 1956. R. M. Davison and A. Farmer.

Details and Results of Trials With Use of Growth Substance Sprays on Outdoor Tomatoes. *N.Z. Com. Grower 10 (12)*:4–5. 1955. R. M. Davison and Greta Priestly.

Incorporation of Fungicides in Fruit-setting Sprays for Control of *Botrytis* Fruit Rot in Glasshouse Tomatoes.

I. Introduction and Screening Trials. *N.Z. J. Sci. Tech. A38*:166–76. F. J. Newhook and R. M. Davison.

II. Compatibility of Mixtures. *Ibid. A38*:177–9. R. M. Davison and F. J. Newhook.

III. Tests in Commercial Houses. *Ibid. A38*:180–3. F. J. Newhook and R. M. Davison.

Some Aspects of *Botrytis* Control on Glasshouse Tomatoes. *N.Z. Com. Grower 12 (3)*:8. 1956. F. J. Newbrook and R. M. Davison.

Methods of Handling Peach Stones for Production of Seedling Stocks. *Orchardist of N.Z. 29 (3)*:16–7. 1956. A. Farmer.

GEOLOGICAL SURVEY

Director: Mr R. W. Willett

REGIONAL PROJECTS

Geological—Regional surveys on one inch to the mile leading to the publication of a bulletin are proceeding in Fairlie sheet (South Canterbury), Papatowai sheet, Morley sheet, and Hokonui sheet (Southland).

Paleontology—Revision of Jurassic stratigraphy and ammonites of Kawhia is continuing. Permian fauna of Southland continues to be a subject of study at Sedgwick Museum, Cambridge.

Petrology—Petrological studies of the rocks of the Morley sheet (Southland) and of ultra basic intrusives in the South Island are proceeding. Industrial and routine projects occupy much of the time of this section.

Coal—Survey work in all coalfields (except Buller) has been completed, and results are in various stages towards publication.

Four-mile Project—Compilation of existing information and additional field work on the four-mile geological map project is proceeding in central areas of North Island, Wanganui area, Banks Peninsula area, Fiordland, and central Southland.

SPECIAL PROJECTS

Phosphate Search—This is a joint effort with the Bureau of Mineral Resources, Geology, and Geophysics, Canberra. A search entailing a study of the geology has been carried out over Western Samoa and is in progress on the Chatham Islands. A number of areas within New Zealand from which phosphate occurrences have been reported have been examined.

Quaternary Tectonics—The project continues with the generous cooperation of Civil Aviation Section of Air Department. The fundamental data obtained under this project is proving invaluable in certain engineering geological projects.

Pleistocene History—The study of Pleistocene deposits continues at an increased pace. Mapping and correlation of such deposits is in progress in the Waikato, Rotorua, Wellington, Canterbury, Westland, and

Southland. ^{14}C-age determinations are used where suitable material offers. In order to co-ordinate all work, and assist workers in this field, a D.S.I.R. Pleistocene Research Committee is being set up.

Geological Map of New Zealand—To replace the 1947 wall geological map, work on the draughting for publication is proceeding on a new scale map on the scale of 1 : 2,000,000.

Paleontology—Cataloguing of type holdings for publication proceeds. Revision of holding of graptolites and some re-collecting has been undertaken. Preparation of a New Zealand stratigraphic lexicon as a part of an international undertaking, with a view to publication, is proceeding.

INDUSTRIAL AND ROUTINE PROJECTS

Geothermal—The knowledge gained by the geological study of Wairakei is being applied to other proposed areas of geothermal power. Air photograph interpretation continues to play an important role. Petrological studies of hydrothermal alteration of the rocks have now gathered some important fundamental data, and publication is now the objective.

Uranium—Over the past year increasing attention has been given to the geology of the occurrences of uranium minerals in Buller Gorge area. A field office has been established at Westport and a field team have been actively mapping. Understanding of the stratigraphy and structure is emerging, and its bearing on the prospects of economic deposits is of more than ordinary importance. Mineralogical studies are of fundamental importance in the study of uranium minerals and, with petrological work, are being pursued vigorously. Generous assistance is being given by the United Kingdom Atomic Energy Authority.

Agriculture Minerals—Serpentine and dunite deposits have been examined, particularly in the Nelson district where development is under consideration. Limestone deposits were examined in several localities scattered through New Zealand.

Foundation Problems—Bridge, building, and dam foundations continue to form an important industrial project. Geological work of this nature is under way in the Waikato, eastern Rotorua district, South Canterbury, and Otago.

Coal Mines—Day-to-day advice to coal mine operators continues, more especially in the West Coast and Waikato areas.

Ground Water—Advice of the Geological Survey is continually sought by farming and industrial interests on the availability of ground water in a number of areas in New Zealand.

PUBLICATIONS

Lower Mesozoic Plant Fossils from Black Jacks, Waitaki River, South Canterbury. *Trans. Roy. Soc. N.Z. 83*:663–72. Shona Bell, H. J. Harrington, and I. C. McKellar.

Petroleum Exploration in New Zealand 1955. *A'Asian Oil and Gas J. 2*:4–7. B. W. Collins.

Underground Water Supplies for Irrigation. *Proc. Lincoln College Farmers Conf. 1956*:70–85. B. W. Collins.

Trans-Tasman Relationships in Natural History. *Science in New Zealand*: 228–46. A. H. and A. W. Reed (Wellington). C. A. Fleming.

A New Species of Scallop from Byron Bay, New South Wales. *Aust. Zool. 12*:108–9. C. A. Fleming.

Proposed Use of Plenary Powers to Suppress the Specific Name *"munda"* Kuhl 1820 in the Combination *Procellaria munda* and *Nectris munda*. *Bull. Zool. Nomen. 12*:16–8. C. A. Fleming, *et al.*

Contributions to the Correlation and Fauna of the Permian in Australia and New Zealand (New Zealand portion). *J. Geol. Soc. Aust. 2*:95–6. C. A. Fleming.

Prospecting for Radioactive Minerals in New Zealand. Revised Edition. *N.Z. Dept. sci. industr. Res. Inf. Ser. 8*. L. I. Grange.

Eruption of Ngauruhoe 1954–55. *N.Z. J. Sci. Tech. B37*:675–88. D. R. Gregg.

Maori: Rock-paintings at Lake Tarawera, New Zealand. *J. Pol. Soc. 65*:364–6. D. R. Gregg.

Geothermal Power. *Science in New Zealand*:112–33. A. H. and A. W. Reed (Wellington). G. W. Grindley.

A Preliminary Account of Layering in Gabbroic Rocks at Bluff Peninsula, Southland. *N.Z. J. Sci. Tech. B38*:103–8. H. J. Harrington and I. C. McKellar.

The Geology of Mount Camel, Northland. *Ibid. B38*:89–96. H. J. Harrington and R. F. Hay.

The Relationships of the Argillaceous Limestones and Greensands at Pahi Peninsula, North Auckland. *Ibid. B38*:69–75. R. F. Hay.

Report of the Standing Committee on Volcanology. *Proc. 8th Pac. Sci. Cong. 2*:27–30. J. Healy. (N.Z. section pp. 7–19 edited by J. Healy).

Recent Volcanicity at Taupo, New Zealand. *Proc. 8th Pac. Sci. Cong. 2*:113–27. I. L. Baumgart and J. Healy.

Preliminary Account of Hydrothermal Conditions at Wairakei, New Zealand. *Proc. 8th Pac. Sci. Cong. 2*:214–27. J. Healy.

The Geology of the Kohurau Fault Block, Central Hawke's Bay. *N.Z. J. Sci. Tech. B38*:342–53. J. T. Kingma.

The Earthquake Risk in the Wellington District. *N.Z. Science Review 14*:131–5. G. J. Lensen, G. R. Stevens, and H. W. Wellman.

Paleozoic Coral from New Zealand. *N.Z. Geol. Surv. Pal. Bull. 25*. Dorothy Hill and Heather Leed.

The Otapirian Stage of the Triassic System of New Zealand. Part I. *Trans. Roy. Soc. N.Z. 83*:695–704. J. D. Campbell and I. C. McKellar.

Geology of the Takahe Valley District Eastern Murchison Mountains. *N.Z. J. Sci. Tech. B38*:120–8. I. C. McKellar.

Petrology of the lower Mesozoic Rocks of the Wellington District. *N.Z. Geol. Surv. Bull. n.s. 57*. J. J. Reed.

Leaves of Middle and Upper Cretaceous Pteridophytes and Cycads from New Zealand. *N.Z. J. Sci. Tech. 83*:673–85. D. R. McQueen.

Ground Water in the Waikato. *N.Z. J. Agric. 93*:67. J. C. Schofield.

Earth Movements in the Wellington Area. *N.Z. Geog. 12*:189–94. G. R. Stevens.

Hutt Valley Artesian System. *N.Z. J. Sci. Tech. B38*:149–56. G. R. Stevens.

Stratigraphy of the Hutt Valley, New Zealand. *Ibid. B38*:201–35. G. R. Stevens.

Geomorphology of the Hutt Valley, New Zealand. *Ibid. B38*:297–327. G. R. Stevens.

Solifluxion Phenomena in the Lower Hutt Area. *Ibid. B38*:279–96. G. R. Stevens.

Air Drying of Coal. *Ibid. B38*:139–48. R. P. Suggate.

Depth-volatile Relations in Coalfields. *Geol. Mag. 93*:201–17. R. P. Suggate.

New Zealand Coals. *Nature 178*:757. R. P. Suggate.

Structural Outline of New Zealand. *N.Z Dept. sci. industr. Res. Bull. 121*. H. W. Wellman.

The Cretaceous of New Zealand. *XX Congr. Geol. Internac., Mexico, Resum. Trab. Present.*:351–2. H. W. Wellman.

Geology of the Gore Subdivision. *N.Z. Geol. Surv. Bull. n.s.* 53. B. L. Wood.

Evidence of a Possible Gymnospermous Affinity for *Tricolpites troedssonii* Erdtman. *New Phytologist 55*:280–5. R. A. Couper.

Supposedly Colpate Pollen Grains from the Jurassic. *Geol. Mag. XCII*:471–5. R. A. Couper.

GEOPHYSICS DIVISION

Director: Dr E. I. Robertson

PROJECTS

Apia Observatory—Continuous recording and analysis of earthquake data; and continuous recording and analysis of the geomagnetic field. Installation of modern magnetic instruments completed.

Magnetic Survey—Continuous recording and analysis of the geomagnetic field at Amberley; study of secular variation and preparation of magnetic charts for the south-west Pacific area; and fluxgate magnetometers for use in ionospheric and volcanological research completed. International Geophysical Year geomagnetic project.

Geophysical Observatory—Continuous recording and analysis of ionospheric conditions at Christchurch, Rarotonga, and Campbell Island; assistance to Canterbury College Industrial Development Department with construction of panoramic ionosondes; relations between the true and virtual heights in the ionosphere and study of the theory of layer formation; diurnal variations at conjugate stations; structure of F_2 layer; and ionospheric storms. Continuous recording and analysis of cosmic ray intensity at Christchurch; and construction of Meson telescope for use at Invercargill. International Geophysical Year ionospheric and cosmic ray projects.

Seismological Observatory—Continuous recording and analysis of earthquake data; provision of New Zealand time service; crustal structure of New Zealand region; strain-release characteristics of after-shocks, earthquake swarms, and historical New Zealand earthquakes; seismic travel-times in New Zealand region; and investigation of deep earthquakes. International Geophysical Year seismological and latitude-longitude projects.

N.Z. Oceanographic Institute—Physical oceanography: field work on the study of off-shore hydrology and plankton (completed), and measurements of Cook Strait tidal movements by tide gauge and by e.m.f. induced in the cross-Strait cable. The nature of the Antarctic convergence, and hydrology of the Southern Ocean; the installation of tide gauges at Campbell and Raoul Islands and McMurdo Sound for the International Geophysical Year (completed).

Marine Biology: distribution and behaviour of fouling organisms (completed); studies of the micro-distribution of plankton and the bottom faunas of Hawke Bay. Investigation of the microbiology of Milford Sound and observation of hydrology, and sediments and bottom faunas in Milford Sound.

Marine Geology: ^{14}C dating and studies of the sedimentary history of the Pleistocene period; the distribution of Recent and Pleistocene sediments in Hawke Bay; studies of the Pleistocene terrestrial sediments; and assessment of the structural significance of the sea-floor features around New Zealand.

Geophysical Survey—Investigation of the Benmore and Waitaki dam sites and Haast river bridge (completed); Cook Strait power cable survey (completed); and magnetic and gravity surveys for oil prospecting companies and flood control project at Balclutha (completed). Elastic properties of dam site foundation rock; convergence measurements in coal mines; paleomagnetism of volcanic rocks; and establishment of volcanological observatory and gravity surveys.

PUBLICATIONS

Electron Distribution in the Ionosphere. *J. Atmos. Terr. Phys. 8*:184–5. G. A. M. King.

Electron Distribution in the Ionosphere. *Ibid. 8*:270–3. G. A. M. King and C. H. Cummack.

Note on Alpha Particle Stars in Nuclear Emulsions. *N.Z. J. Sci. Tech. B37*:671–4. A. C. Stanbury.

Crustal Structure Project. *Dept. sci. ind. Res. Geophysical Memoir 5*. G A. Eiby and R. R. Dibble.

Earthquake Risks in the Wellington Area. *N.Z. Sci. Review 14*:109–20. R. R. Dibble.

Geophysics. *Science in New Zealand*:36–45. A. H. and A. W. Reed (Wellington). E. I. Robertson.

The Nature and Development of Primary Films on Surfaces Submerged in the Sea. *N.Z. J. Sci. Tech. B38*:44–57. T. M. Skerman.

A Method of Recording the Direction of Travel of Ocean Swell. *Deep-sea Research 3*:206–13. N. F. Barber and D. Doyle.

Post-war Oceanography. *Science in New Zealand*:262–72. A. H. and A. W. Reed (Wellington). R. M. Cassie.

Studies on the New Zealand Amphipodan Fauna. No. 13. Sandhoppers of the Genus Talorchestia. *Trans. Roy. Soc. N.Z. 84*:359–89. D. E. Hurley.

The Trans-Tasman Dispersal of White-fronted Tern (*Sterna Striata* G. M.). *Notornis 7 (3)*. W. C. Clark and E. W. Dawson.

The Seismic Determination of Young's Modulus and Poisson's Ratio for Rocks *in Situ*. *Geotechnique 6*:118–23. F. F. Evison.

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I Convergence Observations. *N.Z. J. Sci. Tech. B37*:716–30. F. F. Evison and W. I. Reilly.

II. Model Analysis. *Ibid. B38*:129–38. F. F. Evison and W. I. Reilly.

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GRASSLANDS DIVISION

Director: Dr P. D. Sears

PROJECTS

Plant Physiology—Influence of environment and of defoliation on the growth patterns of major pasture species; influence of different levels of temperature and light on the growth of pasture species and on the proportion of plant tissue constituents, under controlled environments; daily changes in growth of ryegrass in a pasture; the annual changes in tiller number of various species in unit pasture areas; the establishment of a series of microclimate stations throughout N.Z.; the production under various conditions of rapid growth of ryegrass believed to be associated with facial eczema; and the effect of nitrogen and of other plant nutrients on the seasonal growth and on the summer survival of ryegrass strains.

Plant Breeding and Genetics—The maintenance and improvement of the species and strains: perennial ryegrass, Italian ryegrass, H.1. ryegrass, cocksfoot, timothy, white clover, broad red clover (cowgrass), Montgomery red clover, *Lotus uliginosus, Lotus corniculatus,* zigzag clover, H.1. X perennial ryegrass hybrids, tall fescue and hybrids with perennial ryegrass. Improved strains of the first eight of the above species have already been released and are under Government certification, but further improvement work is being carried out on them as well as on those not yet released. In addition, single plant and sward comparisons of several other species and strains, particularly of strawberry clover, subterranean clover, and meadow fescue, are continuously under way. Other projects are: trials of zig-zag clover in South Island tussock country; the production of a white clover strain that breeds true for an easily identifiable leaf marking; the production genetics of ryegrass: the production and study of polyploids in red clover and *Lotus*; studies to ascertain whether genetic differences exist between ryegrass plants in their ability to grow at different levels of mineral nutrients and their ability to absorb mineral nutrients; and studies of techniques with the aim of improving certification procedures, notably node counts in red clover strains.

Pasture Ecology—The rate of increase of soil fertility under pastures of different botanical composition and with different management, and the rate of decrease under different cropping systems; the effect of artificial nitrogen on seasonal and total production; effects of mineral fertiliser, phosphorus, sulphur, lime, and molybdenum; and grass grub and its effect on different species; effects of grazing intensity on seasonal production, and its relationship with leaf area and total light interception at different seasons of the year; the effect of stock treading on pasture composition and growth, and on soil structure and compaction; the use of hormone sprays for weed control; the introduction of grasses

and legumes into established pastures by overdrilling; establishment of new pastures; the use of sodium metabisulphate for ensilage, and the effect of different silage harvesting systems; comparison of farming systems for fat lamb production on lowland; hill country management in relation to soil conservation and animal thrift; a study of the factors involved in maximum butterfat per acre production (in collaboration with Massey Agricultural College); and collaborative trials with Crop Research Division on the performance of new potato varieties under high soil fertility at Palmerston North.

PUBLICATIONS

The Anatomy of the Vegetative Shoot of *Paspalum dilatatum* Poir. *N.Z. J. Sci. Tech. A37*:600–5. Kathleen Soper.

The developmental Anatomy of Perennial Ryegrass (*Lolium perenne* L.) *Ibid. A37*:484–504. Kathleen Soper and K. J. Mitchell.

The Rate of Growth of Short-rotation Ryegrass Pastures in the late Autumn, Winter, and Early Spring. *Ibid. A38*:78–87. R. W. Brougham.

Growth of Pasture Species Under Controlled Environment.

I. Growth at Various Levels of Constant Temperature. *Ibid. A38*:203–16. K. J. Mitchell.

Effect of MCPB (Sodium 2-Methyl-4-Chlorophenoxybutyrate) on Young Red Clover *(Trifolium pratense)* and Weeds. *Ibid. A38*:397–402. D. B. Edmond.

Sheep Management on Improved Hill Pastures. *Proc. N.Z. Anim. Prod. Soc. 16*:39–47. F. E. T. Suckling.

New Zealand Climatic Production Potentials of Pasture Plants. *Ibid. 16*: 48–53. K. J. Mitchell.

Pasture Establisment on Pumice Soils. *Proc 17th Conf. N.Z. Grassl. Ass. 1955*:149–50. P. D. Sears and R. M. Greenwood.

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The Use of Sodium Bisulphite in Silage Making. *Proc. 9th Ann. Mtg. Dairyfarms, Massey Agric. Coll., 1956*:158–60. P. D. Sears.

Dairy Farming Requirements. *Ibid.* 73–7. P. D. Sears.

Breeding for Quality in Pasture Plants. *Ibid.* 47–51. L. Corkill.

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The Basis of Synthetic Strains of Cross-pollinated Grasses. *Proc. 7th Internat. Grassl. Cong. 1956.* 11 pp. L. Corkill.

The Use of Discriminant Functions in the Selection of Pasture Plants, With Particular Reference to the *Lolium Species. Ibid.* 11 pp. A. C. Glenday and S. O. Fejer.

The Influence of Light and Temperature on the Growth of Pasture Species. *Ibid.* 12 pp. K. J. Mitchell.

The Effect of the Grazing Animal on Pastures. *Ibid.* 12 pp. P. D. Sears.

Agricultural Aspects of Soil Moisture. Proc. Conf. Soil Moisture held at Dom. Phys. Lab., Sept. 1954. *N.Z. Dept. sci. industr. Res. Inf. Ser. 12*:46–56. K. J. Mitchell and G. W. Butler.

HOP RESEARCH STATION

Superintendent: Dr R. H. J. Roborgh

PROJECTS

From 3,300 hop seedlings planted in the seedling gardens, some 14, which have passed the test for susceptibility to root rot (*Phytophthora* sp.) in the laboratory, are of good yield and quality. A layering technique for obtaining a maximum quantity of planting material of these promising seedlings has been applied; by this means it will be possible to increase the rate of propagation by about eight times per year.

Amongst the New Wye varieties imported from England a few years ago, the Bullion variety appears to be the only one that produces an average crop each year under our climatic conditions. Experience from overseas, as well as our own results, indicate that the Bullion variety is commercially resistant to root rot, so it may become the first new variety to replace the Californian on the root-rot susceptible soils.

As the annual shoots of the hop plant in the first four to six weeks after shooting are mainly fed by the products that are accumulated in the storage roots, and by the assimilates of the newly developed leaves, it seemed reasonable to expect a relationship between the soil temperatures of the four to six week period and the yield. It was found over the last five seasons that the variance of the regression coefficient of the daily (4 in.) soil temperatures in the first four to six weeks of the growing season is closely correlated to the average yield of the district. This enables a forecast to be made very early in the season of the average yield of the district.

Breeding—The study of botanical characters to aid differentiation of hop varieties; the introduction and evaluation of hop varieties from overseas; the breeding of new hop varieties resistant to root rot (*Phytophthora* sp.); the germination of hop seed; the technique of test for susceptibility to root rot at the seedling stage; the technique of rapid propagation of promising seedlings; and the raising of polyploids.

Agricultural Ecology—Wiring the hop garden at different heights; spacing the hop hills; cultivation and covercropping on different soil types; manuring, particularly for influence on the occurrence of root rot; pruning at different times throughout the year; the evaluation of different stringing methods; training different types of vines; picking by hand with and without cutting the vines; and drying conditions.

INFORMATION BUREAU

Officer in Charge: Mr N. A. Marris

PROJECTS

The work of the bureau has included the editing and publishing of the *New Zealand Journal of Science and Technology* and other departmental publications, the provision of central library services (inter-library lending, book ordering, and reference facilities), a technical information section, a public relations and publicity section, a translation section, a photographic section, a photo-copy service, and (for staff information) the issuing each month of the *D.S.I.R. Newsletter.*

PUBLICATIONS

The Bureau has edited and published, in addition to the *Journal,* some twenty bulletins, memoirs, etc., on behalf of the Department and branches. Those not set out in the individual lists of branch publications included the annual report and the third edition of the *Departmental Handbook.* The first printed departmental *List of Publications,* comprising the main series of printed publications issued by the Department and its branches since establishment, was published during the year.

PLANT CHEMISTRY LABORATORY

Director: Dr A. T. Johns

PROJECTS

Legume Nodule Bacteria—Survey of the effectiveness patterns of local clover *Rhizobia;* determination of the number of *Rhizobia* present in different soils and the effect of different treatments on these numbers; investigations of powdered media for *Rhizobia;* and observations on the establishment of legumes on sand country.

Non-protein Nitrogen Fractions of Pasture Plants—The "bound amino acid" fraction in the nodules of legumes, with particular reference to clover nodules; the "non protein nitrogen" of herbage with respect to the large discrepancies that occur at different stages of growth, particularly under nitrate nutrition; and fractionation of soluble constituents of grass and clover plants grown under conditions of high or low light and high or low temperature.

Underground Transference of Nitrogen from Clover to Grass.

Iodine Nutrition of Grazing Animals—Particularly with respect to strain differences in iodine content of pasture plants and possible goitrogenic substances in clovers.

Uptake of Ions by Plants.

Bloat in Cattle—Field control measures; investigation of fundamental causes of the disease; and physiology of rumen movements in normal and bloating animals.

Carbohydrate Chemistry—Bacterial polysaccharides in the rumen; and carbohydrates in pasture species.

Lipids in Pasture Species.

Plant Proteins—Survey of variation in soluble protein content of pasture plants with season; study of protein of clover nodules and of root tissue; characterisation of proteins derived from leaf cells; and study of the release of protein from plant material in the rumen and its metabolism.

Ruminant Metabolism—A study of the composition of ruminant saliva, and conditions in the rumen as related to changes in chemical composition of pasture.

PUBLICATIONS

Relationship between Photosynthesis and a Homogenous Protein Component of Plant Cytoplasm. *Nature 177*:283–4. J. W. Lyttleton.

Goitrogenic Effect of White Clover (*Trifolium repens* L.). *N.Z. J. Sci. Tech. A38*:88–102. D. S. Flux, G. W. Butler, June M. Johnson, A. C. Glenday, and G. B. Petersen.

Photosensitivity Diseases in New Zealand.
IX. The Susceptibility of the Guinea Pig to Facial Eczema.—*Ibid. 438*:491–6. J. V. Evans, D. McFarlane, C. S. W. Reid, and D. D. Perrin.

Limitations of Present Methods of Controlling Bloat. *Proc. N.Z. Anim. Prod. Soc. 16*:122–7. C. S. W. Reid.

Pasture Establishment on Pumice Soils. *Pro. 17th Conf. N.Z. Grassl. Ass. 1955*. 149–50. P. D. Sears and R. M. Greenwood.

Bloat Investigations. *Ibid.* 70–9. C. S. W. Reid.

Radioactive Isotopes in Agriculture. *Proc. 9th Ann. Mtg. Dairyfrms., Massey Agric. Coll., 1956*: 57–63. G. W. Butler.

Protein of Pasture Plants. Cytoplasmic Protein of White Clover and Italian ryegrass. *Biochem. J. 64*:70–80. J. W. Lyttleton.

The Influence of High Production Pasture on Animal Health. *Proc. 7th Internat. Grassl. Cong.; 1956*. 11 pp. A. T. Johns.

The Underground Transference of Nitrogen from Clover to Associated Grass. *Ibid.* 11 pp. G. W. Butler and N. O. Bathurst.

Agricultural Aspects of Soil Moisture. Proc. Conf. Soil Moist., Dom. Phys. Lab. 1954 *N.Z. Dep. sci. industr. Res. Inf. Ser. 12*:46–56. K. J. Mitchell and G. W. Butler.

Bloat. *Vet. Rev. Annot. 2*:107–34. A. T. Johns.

Effect of the Rumen on Dietary Fat. F. B. Shorland, R. O. Weenick. A. T. Johns. *Nature 175*:1129.

The Iodine Nutrition of Grazing Animals. *Proc. N.Z. Inst. Agric. Science, 1956*. G. W. Butler, D. S. Flux, J. M. Johnson, and G. B. Petersen.

Factors Influencing the Iodine Content of Pasture Herbage. *Nature 179*: 216–7. G. W. Butler and J. M. Johnson.

PLANT DISEASES DIVISION

Director: Dr G. H. Cunningham

PROJECTS

Entomology—General: taxonomy of *Acalyptera* (Diptera); reorganisation of beetle collections; survey of leaf rollers on citrus and their adult and larval taxonomy; and compilation of list of recorded host plants of insects of New Zealand.

Insecticides: physiological effects of DDT on insects; control of Australian carpet beetle; control of timber insects, particularly existing infestations; and assessment of malathion as an insecticide.

Insect resistance in crops: physiological basis of resistance of swedes to aphid attack.

Economic Mycology—Varietal resistance and physiological races of french bean rust; physiological races of tomato leaf mould (co-operative projects with Crop Research Division); therapeutant control of lettuce ring spot (co-operative project with Horticulture Division, Department of Agriculture); and resistance of hops to black root rot (co-operative project with Hop Research Station).

Field crop diseases: studies on powdery mildew, take all, septoria leaf blotch, and root rot diseases of wheat; dry rot, club root, and virus diseases of brassicas; pink root rot, and virus diseases of potato; lucerne diseases; sclerotinia rot of clovers; ryegrass leaf rust; and white rot of onions.

Studies on death of pines; control of silver leaf of stone fruit; and soil treatment with soluble fungicides for control of soil fungi.

Maintenance of a list of all plant diseases recorded in New Zealand.

Systematic Mycology—Collection and identification of New Zealand fungi for herbarium; preparation of monographs on genera of the Thelephoraceae; taxonomic and life history studies of New Zealand Hypocreaceae; taxonomic studies of New Zealand Myxomycetes; and description of further species of *Uredinales*.

Bacteriology and Microbiology—Blast of stone fruit (*Pseudomonas syringae*): studies on relationship of temperature to infection; development of resistant strains following exposure to streptomycin; determination of pathogenicity of resistant strains; effectiveness of combinations of streptomycin and oxytetracycline in delaying or preventing emergence of resistant strains; and assessment of efficiency of streptomycin agricultural spray formulations for control.

Investigations on absorption of streptomycin by plant foliage; antifungal antibiotics; classification and antibiotic properties of actinomycetes in New Zealand soils; and streptomycete populations in selected soils.

Studies in deterioration of tomato products; discolouration in blue-vein cheese; and yeast strains, resistant to normal preservatives, causing deterioration of cordials and aerated water.

Control of plum canker and soft rot; protection of seedlings against attack by crown gall; and studies on bacterial diseases of carnations and mulberry.

Maintenance of certification scheme for legume seed inoculants; development of improved techniques for testing efficiency of *Rhizobium* strains; and search for improved strains of *Rhizobium*.

Virus Diseases—Cause and control of lettuce big vein disease; studies on transmission effect on yield, and varietal resistance of a virus disease of clover, and studies on virus diseases of rose and sweet potato.

Inhibition of viruses by analogues of natural purines and pyrimidines; and studies on nucleic acids in relation to virus multiplication.

Fruit tree virus investigation (in collaboration with Fruit Research Station): identification of virus diseases of pip and stone fruits, investigations on their effect on tree growth, and yield and control by heat treatment, the use of virus-free stocks and scions, and by eradication.

Studies on cause and control of blotchy ripening in tomatoes.

Plant Therapeutants—Investigation of weather in relation to apple black spot with a view to possible introduction of disease forecasting; haulm killing for control of late blight in potato tubers; biology and control of ripe spot of apples; evaluation of plant therapeutants by laboratory, glasshouse, and field methods; and maintenance of a system of certification of plant therapeutants.

Horticulture—Investigations on chemical control of *Oxalis* spp., mist propagation of cuttings; methods of compost preparation; and maintenance of a post-entry quarantine system for the Department of Agriculture.

Timber Preservation—Studies on toxic effects of individual materials contained in multi-salt preservatives.

PUBLICATIONS

Plant Protection in New Zealand, 699 p., Government Printer (Wellington), 1956. J. D. Atkinson, R. M. Brien, E. E. Chamberlain, W. Cottier, J. M. Dingley, H. Jacks, W. D. Reid, and G. G. Taylor.

Willow Leaf of Plums. *Orchardist of N.Z. 30 (1)*:2–3. 1957. J. D. Atkinson, E. E. Chamberlain, and J. A. Hunter.

A Comparison of Glasshouse and Laboratory Methods for Testing Fungicides Against *Botrytis cinerea*. *N.Z. J. Sci. Tech. A38*:506–11. P. J. Brook.

Spray Experiments to Control *Botrytis cinerea* on Tomatoes. *Ibid. A38*: 124–8. P. J. Brook.

A further Note on the Physiologic Specialisation in *Melampsora lini* (Ehrenb) Lev. in New Zealand. *Ibid. B38*:85–8. I. A. M. Cruickshank.

Crown Rust of Ryegrass. *Ibid. A38*:539–43. I. A. M. Cruickshank.

Physiologic Specialization of Oat Crown-rust (*Puccinia coronata* f. sp. *avenae*) in New Zealand. *Ibid. A38*:359–62. I. A. M. Cruickshank.

Study of Phenolic Compounds in Oil-flax (*Linum usitatissimum*) *J. exp. Bot. 7*:410–5. I. A. M. Cruickshank.

Selection for Disease Resistance in Linseed. *N.Z. J. Sci. Tech. A38*:239–47. R. F. M. Van Steveninck and I. A. M. Cruickshank.

Thelephoraceae of New Zealand:

Part VII. The Genus *Lopharia*. *Trans. Roy. Soc. N.Z. 83*:621–8. G. H. Cunningham.

Part VIII. The Genera *Epithele* and *Mycobonia*. *Ibid. 83*:628–36. G. H. Cunningham.

Part IX. The Genus *Stereum*. *Ibid. 84*:201–31. G. H. Cunningham.

Part X. The Genera *Cytidia* and *Aleurocystis*. *Ibid. 84*:232–7. G. H. Cunningham.

Part XI. The Genus *Aleurodiscus*. *Ibid. 84*:237–68. G. H. Cunningham.

Certification of Therapeutants and Plant Hormones. *N.Z. Dept. sci. industr. Res. Inf. Ser.* 13. G. H. Cunningham and J. D. Atkinson.

The Hypocreales of New Zealand.

VII. A Revision of Records and Species in the Hypocreaceae. *Trans. Roy. Soc. N.Z. 83*:643–62. Joan M. Dingley.

New Records of Fungous Diseases in New Zealand 1955–56. *N.Z. J. Sci. Tech. A38*:434–9. Joan M. Dingley and R. M. Brien.

Blast of Pear. *Orchardist of N.Z. 29 (7)*:5, 7. 1956. D. W. Dye.

Oleander Knot (*Pseudomonas savastanoi* (Erw. F. Smith) Stevens). *N.Z. J. Sci. Tech. A38*:407–11. D. W. Dye.

Suggestions for Controlling Blast of Stone Fruit. *Orchardist of N.Z. 29 (4)*:2–3. 1956. D. W. Dye.

The Effect of Temperature on Infection by *Pseudomonas syringae* Van Hall. *N.Z. J. Sci. Tech. A38*:500–5. D. W. Dye.

Horticultural Formulations of Streptomycin. *Orchardist of N.Z. 29 (11)*: 2–3. 1956. M. H. Dye.

Intake of Streptomycin by Peach Leaves. *Nature 178*:551–2. M. H. Dye.

Studies on the Uptake and Translocation of Streptomycin by Peach Seedlings. *Ann. appl. Biol. 44*:567–75. M. H. Dye.

Effect of Foliar and Soil Applications of Insecticides on Control of Aphids and Turnip-mosaic Virus on Swedes. *N.Z. J. Sci. Tech. A38*: 120–3. P.R. Fry and H. Jacks.

Rose-mosaic Virus in New Zealand. *Ibid. A37*:478–82. P. R. Fry and J. A. Hunter.

The Inheritance of Immunity to Pea Mosaic Virus. *Aust. J. Agr. Res. 7*: 272–80. D. E. Yen and P. R. Fry.

A Note on Control of Clover Mite (*Braeobia praetiosa* Koch) on *Dianthus chinensis* L. *N.Z. J. Sci Tech. A37*:523–5. H. Jacks.

Seed Disinfection. *N.Z. Dept. Agric. Bull. 385*. H. Jacks.

Seed Disinfection:

XIII. The Effect of Fungicidal Seed Treatments on Emergence and Covered-smut (*Ustilago kolleri* Wille) of Oats. *N.Z. J. Sci. Tech. A38*:27–9. H. Jacks and I. A. M. Cruickshank.

XIV. Effect of Seed Dressings on Damping-off and Nodulation of Lucerne. *Ibid. A38*:312–5. H. Jacks.

A Note on Field Control of Celery Leaf-spot (*Septoria apii* Chester). *Ibid. A38*:129–31. H. Jacks and A. J. Webb.

A Note on Fungicide Screening for Control of Tomato Leaf-mould. *Ibid. A38*:342–4. H. Jacks and A. J. Webb.

Field Tests for Control of Broad-bean Rust. *Ibid. A38*:157–9. H. Jacks and A. J. Webb.

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The Schradan Content of Fruit and Vegetables. *Ibid. B38*:58–65, P. J. Clark and H. Jacks.

Effects of Some Substituted Purines on Plant Viruses and Virus Diseases. *Atti del vi Cong. int. di Microbiol. Roma. 9*:363–72. R. E. F. Matthews.

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Incorporation of Unnatural Bases into Nucleic Acids. *Proc. III int. Congr. Biochem Brussels, 1955*:63–4. R. E. F. Matthews.

Plant Virus Serology. 128 p. *Cambridge University Press*. 1957. R. E. F. Matthews.

Thiouracil in Tobacco Mosaic Virus. *Biochem. Biophys. Acta 19*:559. R. E. F. Matthews.

Influence of Aliphatic Organic Acids and Metal Ions on Numbers of Local Lesions Produced by a Tobacco Necrosis Virus. *J. gen. Microbiol. 14*:366–70. R. E. F. Matthews and C. H. Procter.

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The Effect of a Synthetic Lysine Polypeptide upon the Velocity of Precipitation of Tobacco Mosaic Virus by its Antiserum. *J. Immunology 72*:435–9. M. A. Stahmann and R. E. F. Matthews.

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The Relationship of Saprophytic Antagonism to Control of *Botrytis cinerea* Pers. on Tomatoes. *Ibid. A38*:473–81. F. J. Newhook.

Incorporation of Fungicides in Fruit-setting Sprays for Control of *Botrytis* Fruit Rot in Glasshouse Tomatoes.
I. Introduction and Screening Trials. *Ibid. A38*:166–76. F. J. Newhook and R. M. Davison.
II. Compatibility of Mixtures. *Ibid. A38*:177–9. R. M. Davison and F. J. Newhook.

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Aquatic Insects of Little Barrier Island. *Rec. Auck. Inst. Mus. 4*:321–7. K. A. J. Wise.

Records of Lepidoptera. *N.Z. Entomologist 2*:19–20. K. A. J. Wise.

Records of Three Common Leaf-rollers. *Ibid. 2*:15–8. K. A. J. Wise.

Glasshouse Tests for Control of Antirrhinum Rust. *N.Z. J. Sci. Tech. A38*:309–11. H. Jacks and A. J. Webb.

SCIENTIFIC LIAISON SERVICE

Officer in Charge: Mr N. A. Marris

ACTIVITIES AND PROJECTS

London—The Senior Scientific Liaison Officer, in addition to keeping the Department advised of recent scientific work and developments, has continued to represent New Zealand on Commonwealth and other special committees. These include Commonwealth Advisory Committee on Defence Science, Commonwealth Advisory Aeronautical Research Committee, Commonwealth Agricultural Bureaux, Management Committee of the Bureau of Animal Nutrition, Board of Governors of Imperial College, O.E.E.C. Co-operative Research Committee, and Commonwealth Council of Oceanography. He is also an assessor on the Food Investigation Board. This officer led the New Zealand delegation to the International Geophysical Year Antarctic Conferences in Paris and Barcelona.

This office has continued to arrange and administer the scientific careers in the United Kingdom of members of the New Zealand Defence Scientific Corps, and of the New Zealand National Research Fellows.

The Assistant Scientific Liaison Officer travelled extensively during the year to agricultural research institutions in Great Britain and Ireland.

The office has also kept a watching brief on the development of the atomic energy power programme, on technological and scientific training, and on irradiation as a method of preserving foodstuffs.

Washington—The work for the past year has included, as before, the acquisition of any Government or private reports and publications covering any phase of scientific research. Congressional Hearings that contained statements made by well-known American scientists have been procured, and also publications relating to air pollution have been obtained and forwarded. Technical information and samples have been sent to New Zealand, and assistance has been given to visiting New Zealand scientists.

A large number of publications dealing with the research work of the Department have been made available to research workers and organisations in the United States.

SOIL BUREAU

Director: Mr N. H. Taylor

PROJECTS

Agricultural

Soil Surveys—North Island: Waiotapu (40 ch./in.), Whakamaru-Rotorua (2 m/in.), Manawatu-Rangitikei sand country (40 ch./in.), revision of Sheet 8 North Island map (4 m./in.), and peat survey, Paekakariki-Paraparaumu (20 ch./in.). South Island: Ellesmere County (40 ch./in.), Taieri Plains (40 ch./in.), Ida Valley (40 ch./in.), Upper Clutha (40 ch./in.), General survey South Island (4 m./in.), and Paparua County (40 ch./in.). Chatham Is. (2 m./in.), Fiji (2 m./in.), Samoa (2 m./in.), and Upolo (40 ch./in.)

Special Investigations—Residual effects of phosphate topdressing in New Plymouth black loam; relation of dental caries to soil type; lysimeter trials, Gore; chemical methods for soil analysis; potassium-supplying power of New Zealand and Pacific soils; systematic survey of inorganic soil colloids; survey of available minerals in soils as extracted by sweet vernal; clay mineralogy of soils of N.Z. and the Pacific Islands; texture standards; survey of physical properties of main genetic groups; laboratory testing of drainage promoting chemicals; field trials of soil "pugging" and surfactants; biological investigation of tussock grassland soils (effect of cultivation); biological investigation of Taita experimental area; identification of soil basidiomycetes by a serological method; biochemical and physiological studies on *Rhizoctonia* spp.; copper survey of main New Zealand soils; reconnaissance survey of tussock grasslands in North Island; effect of liming Taita hill soil as reflected in the chemical composition of the pasture mosaic; mycorrhizae and plant growth; fertility of Cook Island coral sand; and perlite as a growth medium.

Forestry

Soil fertility in Golden Downs State Forest; soils of Tairua State Forest; soils of Ngaumu State Forest; and chemical investigation of litter and humus of red beech.

Engineering

Corrosion of mild steel in soils; cathodic protection of steam bore casings at Wairaki; frost action in soils under highways; volume changes during drained and undrained triaxial tests on granular materials; physical properties of New Zealand estuarine soils; effect of rate of loading on consolidation; and foundation survey, Mount Maunganui industrial area.

PUBLICATIONS

Methods of Chemical Analysis for Soil Survey Samples. *Soil Bureau Bull. 12*. A. J. Metson.

Ion Exchange Phenomena in Some Soils Containing Amorphous Mineral Constituents. *J. Soil Sci. 7*:130–47. K. S. Birrell and M. Gradwell.

Pollens of *Nothofagus* (Variations in Size and Number of Apertures from Flower to Flower on the Same Tree). *N.Z. J. Sci. Tech. B37*:635–8. W. F. Harris.

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A Statistical Design for Fertiliser Experiments on Variable Hill Soils. *N.Z. J. Sci. Tech. B38*:112–9. H. S. Roberts and R. B. Miller.

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Proc. Soil Moisture Conf., held at Dom. Phy. Lab., Sept. 1954. *N.Z. Dept. sci. industr. Res. Inf. Ser. 12*:9–14. H. S. Gibbs

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Effect of Phosphate Topdressing on the Distribution of Phosphorus in a Soil Formed from Andesitic Ash. *Ibid. II*:629–34. W. M. H. Saunders.

Soil Conservation in the Gisborne - East Coast Region of New Zealand. *Ibid. VI*:675–82. W. A. Pullar and A. A. P. Metsers.

Yellow-grey Earths of South Island of New Zealand. An example of Polygenesis in Soil Development. *Ibid. V*:665–672. J. D. Raeside.

The Uptake of Minerals by Sweet Vernal and its Relationship to Genetic Soil Type. *Seventh Int. Grassland Cong. N.Z. 8 (31)*. N. Wells and M Fieldes.

Soil Type in Relation to Mineral Deficiencies. *Ibid. 9 (32)*. N. H. Taylor, I. J. Cunningham, and E. B. Davies.

Lime-superphosphate Fertiliser Topdressing of Soils from Basalt and Andesite and its Effect on the Element Composition of Grass. 11th Symposium on Plant Analysis and Fertiliser Problems. *6th Int. Cong. Soil Sci., Paris*. N. Wells.

Corrosion of Cement-asbestos and Concrete Pipes in some New Zealand Soils. *N.Z. J. Sci. Tech. B38*:257–78. H. R. Penhale.

Soils and Forestry of the Northern Part of the Te Wera State Forest, Taranaki. (A Study in the Application of Soil Survey to Forest Planning). *Ibid. B38*:157–86. W. T. Ward and G. H. Hocking.

The Quantity and Nutrient Content of Hard Beech Litter. *N.Z. Forestry Res. Notes No. 8*. R. B. Miller and Frances B. Hurst.

Nutritional Aspects of *Mortierella hygraphila* Linn. *Nature 177*:662. R. H. Thornton.

*Significance of Particle-size Fractions in Readily Soluble Phosphorus Extractions by the Acetic, Truog, and Lactate Methods. *J. Soil Sci.* 7:189–202. E. G. Williams and W. M. H. Saunders.

*A Comparison of Techniques for Isolating Soil Fungi. *Trans. Brit. Mycol. Soc. 39*:301–13. C. G. C. Chesters and R. H. Thornton.

*Fungi Occurring in Mixed Oakwood and Heath Soil Profiles. *Ibid. 39*:1. R. H. Thornton.

*Genetic Processes in Some Residual Podzolized Soils of New Zealand. *6th Int. Cong. Soil Sci. Paris, 1956. V*:239–9. L. D. Swindale and M. L. Jackson.

*Influence of Drainage Conditions on Fluoride Soluble Phosphorus in Some Scottish Soils. *Ibid. 11*:797–803. E. G. Williams and W. M. H. Saunders.

*Mycorrhiza of Silver Beech. *N.Z. J. Forestry 7 (3)*:47–60. T. M. Morrison.

New Medium for Raising Vegetable and Flower Seedlings. *N.Z. J. Agric. 93*:503. T. M. Morrison.

Soil Research in New Zealand. The Taita Experimental Station. *Nature 179*:177–9. R. H. Thornton.

Soil Surveys and Their Use to the Farmer. *Proc. Ruakura Farmers Conf.* H. S. Gibbs.

The Soil Pattern of New Zealand. *N.Z. Inst. Agric. Sci. Conf. Proc.* p. 28. N. H. Taylor and J. E. Cox.

Soil Survey of Upper Shotover Catchment. *Otago Catchment Board Bull. 1*:15–23. J. D. McCraw.

Chemistry. *Science in New Zealand:* 46–54. A. H. and A. W. Reed (Wellington). J. K. Dixon.

History of Soil Science. *Science in New Zealand*: 153–63. A. H. and A. W. Reed (Wellington). I. J. Pohlen.

*Papers based on work carried out in university and other research laboratories – mostly overseas.

TOBACCO RESEARCH STATION

Director: Mr R. Thomson

PROJECTS

Seedling Bed Work.

Alternatives to steam sterilisation for the control of weeds and disease; control of damping off; testing of new fungicides and insecticides on tobacco seedlings

The Crop in the Field.

Fertilisers—Most suitable time and form in which to supply nitrogen; use of supplementary nitrogen; effect of boron on yield and quality of different varieties; response of tobacco seedlings to minor elements, copper, manganese, zinc, molybdenum; comparison of high analysis fertilisers with standard mixtures; and demonstration plots to illustrate various deficiencies.

Cultural—Effect of spacing plants on size of leaf and total yield; control of lateral growth by chemicals; cultivation practices in relation

to yield of leaf and spread of mosaic; and irrigation studies on the moisture requirements of the tobacco crop.

Plant Breeding—Breeding for resistance to black root rot; mosaic; verticillium wilt, *Phytophthora* canker; and studies of inheritance.

Variety Trials—Testing of new overseas varieties and locally developed lines.

Seed Production—Maintaining a supply of seed for the industry and building up a reserve.

Kilns and Curing—Fundamental work on curing in cabinets under controlled conditions; and kiln design in co-operation with the Dominion Laboratory.

Insect Pests—Effect on the plant of insecticides in the setting water; investigation into the carry-over of insecticides in the soil; and control of root knot nematodes by soil fumigation.

Diseases—Control of verticillium-wilt organism by soil treatments; persistence on black root rot in infested soil; use of fungicides in the setting water to control seedling stem rots; and study of kiln conditions conducive to mould development.

PUBLICATIONS

A Note on Wind Damage to Tobacco. *N.Z. J. Sci. Tech. A37*:535–7. A. G. McLeod.

A Leaf Breakdown of Tobacco Associated with the Copper Status of the Soil. *Ibid. A37*:584–99. R. Thomson and H. O. Askew.

Use of Lime on Flue-cured Tobacco. *Ibid. A38*:299–308. R. Thomson, Joyce Watson, and R. Monk.

Boron and Flue-cured Tobacco. *Ibid. A38*:326–31. R. Thomson and R. Monk.

Tobacco Growing in New Zealand. *Rhodesian Tobacco 13*:32. R. Thomson.

WHEAT RESEARCH INSTITUTE

Director: Mr E. W. Hullett

Services—Determination of milling and baking qualities of new wheats produced at the Crop Research Division; flour and wheat testing service for millers, bakers, and the Wheat Committee; technical advice on flour manufacture and utilisation, especially on the efficient use of automatic machines in bread bakeries; and fortnightly issue to all bread bakers of lists giving information on the quality and treatment requirements of all New Zealand brands of flour.

Other Projects—Biochemical investigations of the adverse effect on yeast activity of small additions of flour to ferments; measurement of the viscous and elastic properties of flour doughs, especially their relationship with machine dough handling in bakeries and with current views on dough behaviour; simplification of the procedures developed by the Institute for determining optimum operation of mechanical bakery plant with a view to their publication and wider use by bakery production staff; and study of the effectiveness of various modifications made as a result of previous investigations into causes of steam losses from ovens.

PUBLICATIONS

Flour and Bread. *N.Z. School Science 9* (July 1956). E. W. Hullett.

Effect of Oven Door Position on Steam Loss. *N.Z. Baker and Confectioner.* (Jan. 1956). E. W. Hullett, R. Sutherland, and C. A. Crawford.

Report to Bakers' Conference. *Ibid.* (April 1956). E. W. Hullett, R. Sutherland, and C. A. Crawford.

High-ratio Cakes. *Ibid.* (April 1956). Wheat Research Institute.

The Diagnosis of Ingredient Faults in Cakes. *Ibid.* (July 1956). J. Nolan and J. T. Gould.

Methods of Cake Manufacture: Sugar Batter or Flour Batter? *Ibid.* (August 1956). J. Nolan and J. T. Gould.

The Effect of Ingredient Temperature on Cake Quality. *Ibid.* (Sept. 1956). J. T. Gould and J. Nolan.

INCORPORATED RESEARCH ASSOCIATIONS

THE DAIRY RESEARCH INSTITUTE (N.Z.)

Director: Professor W. Riddet

The financial year of the institute ends on 31st July next, after which a separate report will be issued. The investigations under way include studies of the following subjects:

Cheesemaking—Use of freeze-drying techniques in the preservation of cheese-starter cultures; the relationship between lactic streptococci and the bacteriophages that attack them; influence of carbon dioxide on the growth of lactic streptococci and lactobacilli; effect of various anti-oxidants on the oxidation of fat in cheese in relation to tallowy discolouration in cheese; formation of carbon dioxide in cheese and its effect on cheese texture; the effect of various methods of packing and storage on the incidence of discolouration in cheese; the effect of modifications in manufacture on the flavour of cheese; experimental manufacture of Gruyère cheese; cause of the appearance of black spots in Cheddar cheese; moisture losses from stored cheese as affected by waxing conditions, cheese maturity, and fat standardising.

Buttermaking—Vapour-liquid equilibrium relationships and butterfat-water partition coefficients of substances in very dilute solution in relation to the deodorisation of cream; the effects of changes in design and steam-saving techniques applied to cream deodorising equipment on the quality of the resulting butter; effect of addition of starter in varying proportions to cream in the cold on the flavour and keeping quality of butter, both salted and unsalted; quality and keeping quality of non-washed unsalted butter; aggregation and disruption of fat globules in the processing of cream in relation to losses of butterfat in churning; phospholipids in milk and their distribution between cream and skim milk in the separation of milk, and between butter and buttermilk in the churning of cream to butter.

Casein—Collection of data on the effectiveness of casein grinding and sifting equipment in practice and comparing the results with previously obtained pilot plant results.

Dried Milk—The browning reaction in dried milk: effect of various heat treatments during manufacture.

Dairy Process Engineering—The effectiveness of equipment used in the cooling and chilling of farm milk supplies, improvements in cooling equipment, the variations in temperature during cooling, holding, and transport, and the effect of such time-temperature variations on milk quality; the suitability and required performance of refrigerated bulk milk tanks (for farms) to be used for milk tanker collection, and a study of methods of using existing refrigeration equipment in a bulk collection scheme; rates of cream cooling and basic heat transfer rates in a butter factory cream-holding vat; the effectiveness of can-washing equipment as affected by mechanical design; and the collection of data relating to evaporation rates in the concentration and drying of milk and whey.

Dairy Husbandry—Causes of the regular seasonal changes in properties of New Zealand butterfat – effect of lactation and of individual grasses in the pasture complex: effect of ingestion of liquid paraffin by cows

on the colour and vitamin A content of butterfat and butter; causes of changes in the vitamin A content of butterfat; and relation of the carotene and vitamin A contents of blood to vitamin A and carotene contents of butterfat.

Engineering Advisory Service Section—This section supplies a consulting service, giving assistance in relation to size, type and economy of steam boilers, refrigeration equipment, etc., and planning and selection of dairy equipment; machinery testing for manufacturers and importers of dairy equipment is also undertaken.

PUBLICATIONS

The Steam Stripping of Taints from Liquids.
Part IV. An Analysis of Continuous Counterflow Equipment. *J. Dairy Res. 23*:30–47. J. K. Scott.

Variations in the Carotene and Vitamin A. Contents of Herd Butterfats throughout Lactation. *Ibid. 23*:111–9. A. K. R. McDowell.

Steam Distillation of Taints from Cream.
Part II. Investigations on Commercial Equipment With Use of Diacetyl and Acetoin as Reference Substances. *Ibid. 23*:48–64. F. H. McDowall.

Multi-stage Vacreation Halves Steam Usage. *Food Engng. 28*:74–7. J. K. Scott.

The Use of Dried Buttermilk as a Feed for Dairy Calves. *N.Z. J. Sci. Tech. A37*:451–7. D. S. Flux and M. R. Patchell.

The Use of Dried Buttermilk in a Meal Mixture as a Feed for Dairy Calves. *Ibid. A37*:538–41. M. R. Patchell.

Chlorination of Butter Wash Water in Relation to Butter Quality. *Aust. J. Dairy Tech. 11*:52–7. F. H. McDowall and A. K. R. McDowell.

The Use of Dried Buttermilk as a Complete Replacement of Whole Milk for the Rearing of Young Calves. *N.Z. J. Sci Tech. A38*:20–2. D. S. Flux and M. R. Patchell.

A Uniformity Trial with Monozygous Twin Cows. *Ibid. A38*:1–14. M. R. Patchell.

Bulk Starter Preparation in Cheese Factories. *Dairy Engng. 73*:159–63. H. R. Whitehead.

The Effect of Aureomycin Supplement on the Growth and Health of Young Calves. *N.Z. J. Sci. Tech. A38*:23–6. M. R. Patchell.

Science in the Development of the Dairy Industry. *Science in New Zealand*. 176–89. A. H. and A. W. Reed (Wellington). W. Riddet.

MEAT INDUSTRY RESEARCH INSTITUTE OF NEW ZEALAND (INC.)

Director: Mr N. H. Law

This institute was formed in 1955 to undertake research in the meat industry. Its membership comprises all the meat freezing and meat exporting companies (of which there are twenty-one operating thirty-two works), and the New Zealand Meat Producers Board. Finance provided by the members and by Government grants amounts to £40,000 per annum.

Some staff have been recruited, and laboratories are at present in the Dominion Laboratory's buildings until new laboratories are established.

PROJECTS

The structure of muscle proteins, rigor mortis and thaw rigor in lamb, the relaxation factor of muscle, bone taint in beef, and psychrophilic bacteria of meat and meat works.

NEW ZEALAND FERTILISER MANUFACTURERS' RESEARCH ASSOCIATION (INC.)

Director: Dr B. W. Doak

Considerable attention has been given to the development of a DDT-superphosphate mixture which ensures thorough distribution of the DDT, prevents separating out of the DDT during handling or application, yet at the same time gives satisfactory control of grass grub and grass caterpillar. It is believed that by introducing the DDT during the course of manufacture of the superphosphate a very satisfactory product can be obtained. Field tests are being carried out to determine the efficiency of DDT mixes produced in this way. It is considered that this material could be applied from the air without risk.

Work has shown that even with heavy superphosphate applications there is little build-up in available sulphur in soils since leaching loss is considerable. Over 80 per cent of the sulphur in an application of superphosphate at the rate of 1 ton per acre was lost from a 12 in. depth of soil in one season. This shows that annual sulphate applications are desirable where deficiency occurs. Even in the vicinity of the Auckland industrial area the annual loss of sulphur at least equals the amount added to the soil by rain.

PROJECTS

Long-term phosphate trials with various phosphatic materials; the effect of magnesium contained in serpentine super; DDT-superphosphate manufacture; acidulation studies with Nauru and Ocean Islands phosphate rocks, effect of acid strength, amount of acid, fineness of grinding, etc.; and cobalt investigations for effect of various cobalt compounds, including chelates, on the uptake of cobalt by pasture herbage.

PUBLICATION

The Influence of the Calcium Sulphate in Superphosphate on Phosphate Fixation in Soils. *N.Z. J. Sci. Tech. A38*:132–6. B. W. Doak and J. van der Hooft.

NEW ZEALAND LEATHER AND SHOE RESEARCH ASSOCIATION (INC.)

Director: Mr F. W. Woodroffe

PROJECTS

Research—The use of sodium hydrosulphide, calcium chloride, and sodium sulphite in depilatory paints; the effectiveness of fungicides in the modified pickling process; the control of hard spot on wet salted calfskins with boric acid and B. Naphthol; the use of bactericides in the curing of hides; the rapid tannage of sole leather; and the waterproofing of sole leathers.

The effect of synthetic and human perspiration on chromed tanned, vegetable tanned, chrome retanned, and semi-chrome socking leathers; the effect of synthetic perspiration on chrome-collagen complexes; and a comparison between vegetable tanned, chrome retanned, and zirconium retanned sole leathers.

The finishing of paste-dried side leathers; a study of the performance of adhesives in the construction of footwear; and the development of a synthetic resin toepuff.

Service—Five hundred and fifteen inquiries from members have been handled during the year; visits to members are an important service; footwear factories are visited regularly by our recently appointed Footwear Officer.

Technical conferences are now an annual feature for the three industries (fellmongery activities of the freezing works, the tanners, and the shoe industry); and conference reports and progress reports are issued.

NEW ZEALAND POTTERY AND CERAMICS RESEARCH ASSOCIATION (INC.)

Director: Mr I. C. McDowall

PROJECTS

Mechanism of filter pressing and slip casting; properties and performance of refractory concrete; mastic jointing of salt-glazed sewer pipes; investigations carried out in North America into reinforced grouted brick masonry, and application of the system in N.Z.; and clay supplies at Plimmerton.

PUBLICATIONS

Dampness in Building.

Part III. Other Contributory Factors and the Repair of Leaky Walls. *Building Progress, XXII*:5–15. V. A. Youl.

Research into Reinforced Brick Masonry. *Construction 1.* No. 4. V. A. Youl.

Reinforced Brickwork. *Building Progress XXI*:3. V. A. Youl.

Reinforced Brickwork. *N.Z. Engg. 11*:133–4. V. A. Youl.

Reinforced Brickwork in America. *Construction 1.* No. 14. V. A. Youl.

Building Research. *J. N.Z. Inst. Archi. 23*:248–56. V. A. Youl.

Reinforced Brickwork. *Ibid. 23*:68–9. V. A. Youl.

The N.Z. Pottery and Ceramics Research Association (Inc.). *N.Z. Hardware J. 2*:35–7. I. C. McDowall.

NEW ZEALAND WOOLLEN MILLS RESEARCH ASSOCIATION (INC.)

Director: Dr L. F. Story

PROJECTS

Continuation of examination of woollen ring-spinning; effect of oils in worsted processing; correlation of top and yarn strengths and fibre length; examination of new method of controlling felting shrinkage; effect of thyroxine and iodine on wool growth; and initiation of work on (commission) wool scouring.

PUBLICATIONS

Quality of Pre-lambing Shorn Wool. *N.Z. J. Agric. 93*:365–70. L. F. Story, D. A. Ross, R. L. Bratt and K. H. C. Lewis.

Pre-lamb Shorn Wool. *Wool Record 90*:762–5. L. F. Story and D. A. Ross.

Pre-natal and Post-natal Shearing. *12th Annual Report, N.Z. Wool Board*. L. F. Story.

RESEARCH INSTITUTE OF LAUNDERERS, DRYCLEANERS, AND DYERS OF NEW ZEALAND (INC.)

Research Officers: Mr P. Carylon Coates and Mr R. M. L. Paterson

PROJECTS

Education of members or their staff by demonstrations on the institute's plant, at technical conferences; testing of laundry test-pieces for whiteness retention and strength retention for members' information; testing to determine the effect of carefully controlled bleaching; investigation of blues and optical bleaches; trials of permanence of marking inks; tests on relative expectation of life of various textiles; tests on relative depreciation of goods in use and during washing; tests on shrinkage of fabrics in washing; survey of commercial laundries and drycleaning plants; investigation into causes of textile damage in articles processed in laundries and drycleaning plants; testing serviceability of new fabrics in relation to laundering and drycleaning; examination of diatomaceous earths for suitability as filter aids in drycleaning plants; investigation of the resistance to drycleaning solvents of protective gloves made of synthetic rubbers; and process tests on commercial and institutional laundries.

GRANTS-IN-AID TO OTHER INSTITUTIONS

Grants for research in universities and other institutions in 1956–57 were as follows:

	£	£
Auckland University College—		
Seagrove Radio Research Station	4,000	.....
International Geophysical Year	1,500	.....
		5,500
Australian and New Zealand Association for the Advancement of Science		1,500
National Institute of Oceanography (London)		2,500
Canterbury Agricultural College		8,000
Canterbury University College—	£	
Research on meteors	1,500	.....
Industrial Development Department	6,000	.....
		7,500
Carter Observatory—	£	
Statutory Grant	2,250	.....
International Geophysical Year	500	.....
		2,750
Cawthron Institute		10,996
Commonwealth Agricultural Bureaus		14,080
Dr Elizabeth Flint (study of the algae of soils)		280
Massey Agricultural College		8,000
Royal Society of New Zealand		*3,500
Victoria University College—	£	
Ultra-high-frequency Research	700	.....
Iron Sands Investigation	2,000	.....
International Geophysical Year	1,400	.....
		4,100
Incorporated Research Associations		70,876
Scott Polar Research Institute		100
		£139,682

*The Royal Society of New Zealand were also allowed to retain £2,500 held on behalf of the Government, making the actual grant paid from Government funds £6,000 for the year.

CAWTHRON INSTITUTE

Director: Dr D. Miller

During the past year work has been continued on a variety of problems concerned with pastures, soils, hops, tobacco, fruit, and tomatoes. Grants in aid from the Department have been received for these investigations and collaboration with the Tobacco and Hop Research Stations has been maintained.

PROJECTS

Fruit Research—Some favourable responses have been obtained to applications of sodium molybdate to apples and raspberries and to lupin cover crops. At Marsden Research Farm mixed fertilisers and trace elements have been applied to raspberries. Observations on magnesium deficiency of apples have been continued.

Hop Research—Determination of resin contents of hops grown at the Hop Research Station has revealed great variations between different newly-bred plants. Work on chemical changes in hop cones, especially in relation to starch, pentosan, sugar, and resin contents, has been continued. Manurial trials at Marsden Research Farm have been maintained. A breakdown of leaf tissue of hops has been ascribed to molybdenum deficiency. Disease surveys and investigations into control of black root rot *(Phytophthora cactorum)* have been continued. The utilisation of proteins, amino acids, and carbohydrates by this organism is under investigation.

Tobacco Research—Samples of cured tobacco from field experiments at the Tobacco Research Station have been analysed for determination of quality. Disease surveys have been conducted with special reference to incidence of mosaic, *Verticillium* wilt, canker, and black root rot. Tests of resistance of varieties to disease have been carried out in the glasshouse. A destructive rotting of butts and blades of leaves has been investigated: *Rhizopus arrhizus* is implicated but may be secondary to another organism.

Tomato Investigations—In water cultures increased supplies of iron reduced the incidence of "hard core". Shading, especially when combined with high humidity, greatly increased "cloud" in tomato fruits. Control of water supply and of fertilisers have markedly affected the amount of "cloud" under glasshouse conditions. Varieties of tomato have been tested for yield and quality, but so far no variety to replace Potentate has been found.

Pasture Research—Very marked responses to molybdenum were obtained on established pastures on pakihi and on a newly sown pasture on Moutere Hills soils. A potassium response was found on pakihi soil. Use of molybdate and ground limestone in conjunction greatly altered the chemical composition of white-clover leaflets.

Soil Investigations—Advisory work for Tobacco Research Station and Soil Conservation Council, and analyses for survey of Eastern Hills area of Waimea County.

PUBLICATIONS

A Note on an Outbreak of *Verticillium* Wilt in a Nelson Hop Garden. *N.Z. J. Sci. Tech. A38*:15. T. Christie.

Pathogenicity Tests with Species of *Verticillium*. *Ibid. A38*:17–9. T. Christie.

Effect of Steam and Soil Disinfectants on Yield and Quality of Nelson Glasshouse Tomatoes. *Ibid. A38*:66–77. D. J. Stanton.

A Leaf Breakdown of Tobacco Associated With the Copper Status of the Soil. *Ibid. A37*:584–99. R. Thomson and H. O. Askew.

Use of Lime on Flue-cured Tobacco. *Ibid. A38*:299–308. R. Thomson, Joyce Watson, and R. Monk.

Boron and Flue-cured Tobacco. *Ibid. A38*:326–31. R. Thomson and R. Monk.

Black Root-rot, *Phytophthora cactorum* (Leb. and Cohn) Schroet, of the Hop Plant. *Ibid. A38*:277–84. T. Christie.

Use of Molybdenum in Nelson Orchards. *Orchardist of N.Z. 29*:2. 1956. E. Chittenden.

Molybdenum Deficiency in Hops. *Nature 178*:1302. J. Watson and H. O. Askew.

A Conspectus of Entomology. *Science in New Zealand*. 70–7. A. H. and A. W. Reed (Wellington).

UNIVERSITY COLLEGES

CANTERBURY AGRICULTURAL COLLEGE

Director: Dr M. M. Burns

PROJECTS

Agricultural Engineering—Small seeds harvesting; reaction of mounted ploughs upon tractors; tractor-guiding instrument.

Animal Husbandry Department—Corriedale progeny test; fat lamb sire trials; Boarder Leicester cross trial; lucern in sheep nutrition; and thyroxine implantation.

Entomology Department—Thrips infestation of cocksfoot seed crops; white clover case moth; and pollination of red clover.

Field Husbandry Department—Pasture mixtures for light land; lucerne agronomy studies; grazing lucerne breeding; and physiology of lucerne.

Microbiology Department—Microbiology of food; *Rhizobium* inoculation of legumes; root excretion and the rhizosphere; microflora in peas; disease survey; and plant pathology.

Soil Science—The nitrogen cycle in grassland soils; the nutrition of legumes; and lime studies.

Valuation and Farm Management Department—Resource productivity on a sample of Canterbury Plains light land farms with particular attention to the economics to size.

Veterinary Department—Ovine pregnancy toxaemia investigations.

Wool Department—Fleece rot; and wool break.

PUBLICATIONS

The Development of a Continuous Acting Ditch-cleaning Machine. *N.Z. Engineering 11*:75–8. D. L. King.

Thrips Infesting Cocksfoot in New Zealand.

I. Thrips Fauna of a Cocksfoot Seed Crop. *N.Z. J. Sci. Tech. A38*: 52–5. K. M. Doull.

II. The Biology and Economic Importance of the Cocksfoot Thrips *Chirothrips manicatus* Haliday. *Ibid. A38*:56–65. K. M. Doull.

Lucerne – Grass – Clover Mixtures. *Proc. Lincoln College Farmers' Conf. 1955*. J. W. Calder.

Pasture Research at Ashley Dene. *Proc. Lincoln College Farmers' Conf. 1956.* J. W. Calder.

Pigment Production by a Strain of *Pseudomonas aeruginosa* Isolated from the Fleece of Sheep. *J. N.Z. Soc. Bact. 2*:3–8. A. P. Mulcock and I. E. B. Fraser.

Staining of Wool by Bacterial Pigments. *Nature 177*:628–9. A. P. Mulcock and I. E. B. Fraser.

Damage and Loss in Potatoes. *Report, N.Z. Potato Board 1956. Fruit and Produce Journ. Oct. Nov. 1956. Canty. Chamber of Commerce Bull. Mar. 1957.* I. D. Blair.

Plant Pathological Features of the Rhizosphere. *Proc. Sections I.L.M. Dunedin meeting 1957. Aust. and N.Z. Assn. Adv. Science.* I. D. Blair.

Fate of Labelled Nitrate and Ammonium Nitrogen When Applied to Grass and Clover Grown Separately and Together. *Soil Science. 81*:339–51. T. W. Walker, A. F. R. Adams, and H. D. Orchiston.

The Effect of Levels of Calcium Sulphate on the Yield and Composition of Grass and Clover Pasture. *Plant and Soil. 7*:290–300. T. W. Walker, A. F. R. Adams, and H. D. Orchiston.

The Accumulation of Organic Matter in Grassland Soils. *Proc. 6th Int. Soc. of Soil Sci. Paris. Comm. 2*:409–16. T. W. Walker.

The Reaction of Crushed Limestone With an Acid Soil. *Ibid. Comm. 2*: 439–45. B. L. Elphick.

Nitrogen and Herbage Production. 1956. *Proc. 7th International Grasslands Congress. (N.Z.).* T. W. Walker.

The Copper Content of Some Soils and Pasture Species in Canterbury. *N.Z. J. Sci. Tech. 38A, 345–58.* A. F. R. Adams and B. L. Elphick.

The Nitrogen Cycle in Grassland Soils. *J. Sci. Food and Agric., 7, 66–72. 1956.* T. W. Walker.

Observations of Some Treatments of Ovine Pregnancy Toxaemia. *N.Z. Vet. J. 4*:136. G. G. Thomson.

Fleece Rot Studies. *Proc. A.N.Z.A.A.S. Jan. 1957.* A. E. Henderson.

Studies on the Microclimate of the Fleece. *Aust. J. Agric. Res. 8:No. 3. 1957.* I. E. B. Fraser.

CANTERBURY COLLEGE INDUSTRIAL DEVELOPMENT DEPARTMENT

Director: Mr T. R. Pollard

The operation over the past year has been sound financially. The major effort has been on the radio ionosondes for the Antarctic and Rarotonga, but a considerable amount of work has been carried out for industry.

The total financial recovery for the year was £19,200 compared with £15,600 for last year. The number of projects for industry was over 600 as compared with 560 last year. The industrial recovery was £5,000 compared with £6,500 last year, but the ionosondes work limited the amount of industrial work that could be handled, and the figures given above for this year are for nine months only. Less time was necessarily spent on research and development this year.

A considerable improvement in the working conditions has resulted from extensions to the building.

The first radio ionosonde was despatched to the Antarctic in December 1956, and has been in operation. The unit for Rarotonga is in operation in Christchurch but will be shipped soon.

The radiation detector on the dredger *Canterbury* has been operating very successfully. Inquiries have been received from dredge builders in England, Holland, and Italy regarding this equipment.

Two transistor models of the crane protective device have been built and operated satisfactorily, but redesigning to meet the requirements of the Ministry of Works of the second model is progressing slowly. In view of the prevalence of crane accidents with high tension lines it is considered that these units should prove a valuable addition to cranes that are called upon to work near high tension lines.

Developed for the Entomological Division, an apparatus was built to replace the visual counting of aphid clusters on plants. Finally the method used was to utilise the change in resistance as the aphids suspended in a solution passed between two small electrodes in a glass tube, and the apparatus, which is nearly completed, will make it possible to count the aphids not only more accurately but also more of them, a few thousands being counted in a matter of seconds instead of hours.

A number of tests has been carried out on different types of 3-pin plugs with the idea of formulating suitable tests for incorporation in the New Zealand Standard Specification. Testing plugs, P.V.C. cables, and more recently electric blankets and warming pads for various manufacturers and importers of electrical apparatus have been carried out, as the testing authority for the State Hydro-electric Department.

Messrs H. C. Urlwin Ltd., has presented the C.C.I.D.D. with a Hilger medium quartz spectrograph, and other new instruments have been added to the testing laboratory.

MASSEY AGRICULTURAL COLLEGE

Principal: Professor G. S. Peren

PROJECTS

Distribution of bumble bee species in the South Island; leptospira pomona vaccination in calves; inhibition of worm parasitism in sheep grazing certain grasses and clovers in pure stand; the process of development of resistance to parasitism; and epidemiology of round worm parasitism in sheep; the utilisation of carotene by animals; study of mammary gland growth and function; and measurement of levels of hormones in the circulation of animals.

Sheep-breeding experiment; carcass quality and meat investigations; genetics of *N*-type and horns; and endocrinology of reproduction in the sheep.

Pampas research: drainage research; pasture manuring under rotational grazing; and the nutritive value of whey for fattening pigs.

PUBLICATIONS

Further Studies on the Metabolism by Rats of Intravenously Administered Aqueous Dispersions of Carotenoid Pigments. *Brit. J. Nutr. 10*:126. W. A. McGillivray, S. Y. Thomson and N. A. Worker.

The Effect of Complete Hepatectomy on the Utilisation by Rats and Rabbits of Intravenously Administered Aqueous Dispersions of Carotene. *Ibid. 10*:169. N. A. Worker.

The Effect of the Thyroid on the Conversion of Intravenously Administered Aqueous Dispersions of Carotene to Vitamin A in the Rat. *J. Nutr. 60*:447. N. A. Worker.

The Vitamin Content of New Zealand Butterfat. *N.Z. J. Sci. Tech. 38*:466–72. W. A. McGillivray.

Goitrogenic Effects of White Clover (*Trifolium repens* L.). *Ibid. A38*:88–102. D. S. Flux, G. W. Butler, June M. Johnson, A. C. Glenday, and G. B. Petersen.

The Effect of Adrenocorticotrophin on the Mammary Glands of Intact Mature Female Mice of the C.H.I. strain. *J. Endocr. 14*:343. D. S. Flux and R. E. Munford.

Effect of Cyanogenetic Glucoside in White Clover on Thyroid Function. Summary. *A.A.N.Z.A.A.S. Conference.* D. S. Flux, G. W. Butler, June M. Johnson, A. C. Glenday, E. Wright, and G. B. Petersen.

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On the Breeding Season of Romney Ewe Lambs. *Ibid. 17*:T. S. Ch'ang and J. I. Raeside.

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I. Oestrus, Ovarian Changes, and Gonadotrophic Potency of the Pituitary Glant. *Aust. J. Agric. Res. 7*:591. J. I. Raeside and D. R. Lamond.

II. Histological Examination of the Genital Tract. *Ibid. 7*:601. J. I. Raeside and D. R. Lamond.

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Effect of Frequency and Times of Cutting on two Commercial "Strains" of Pampas Grass (*Cortaderia selloana*). *N.Z. J. Sci. Tech. A38*:332–41. W. A. Jacques.

Preliminary Trials With Whey for Fattening Pigs. Summary. *Proc. N.Z. Soc. Animal Prod. 17, 1957.* A. C. Dunkin.

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